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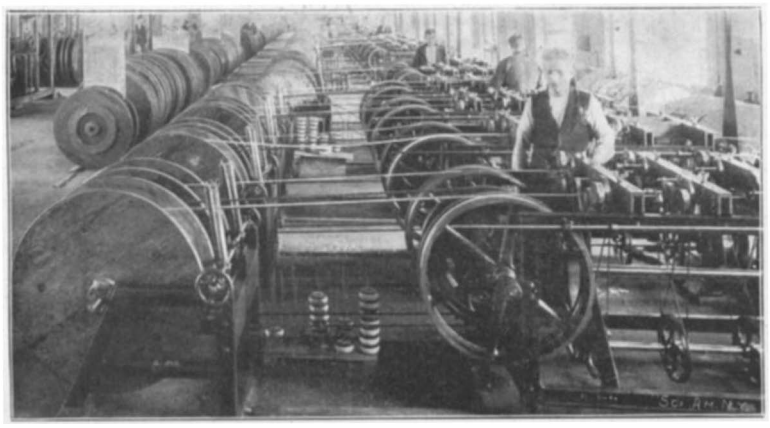

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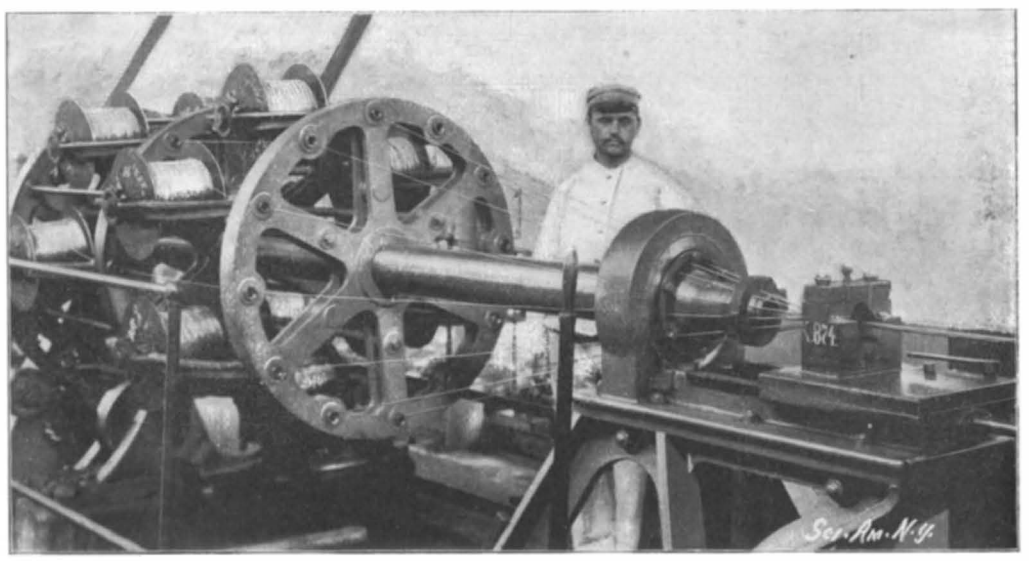

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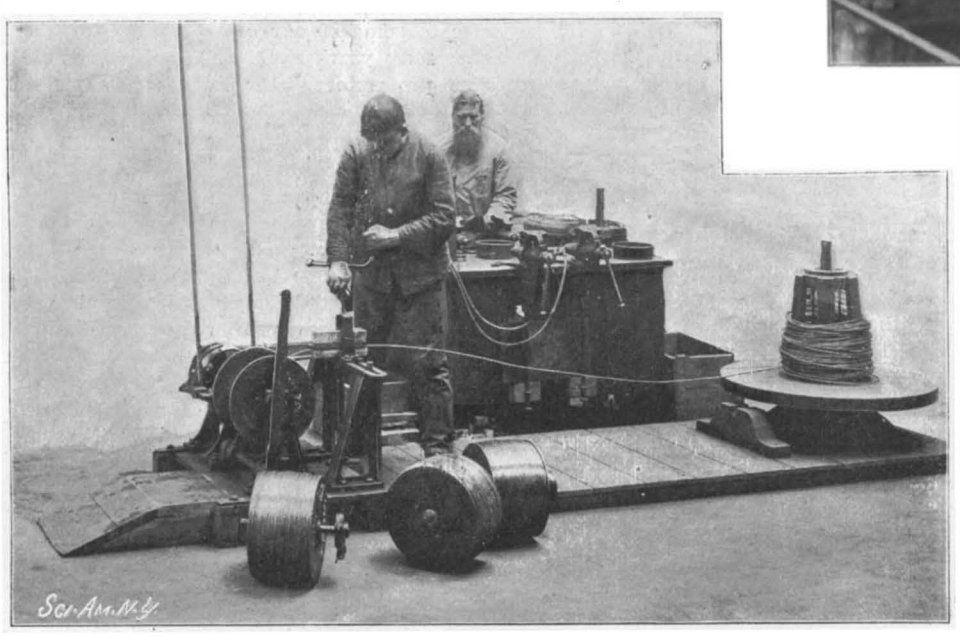

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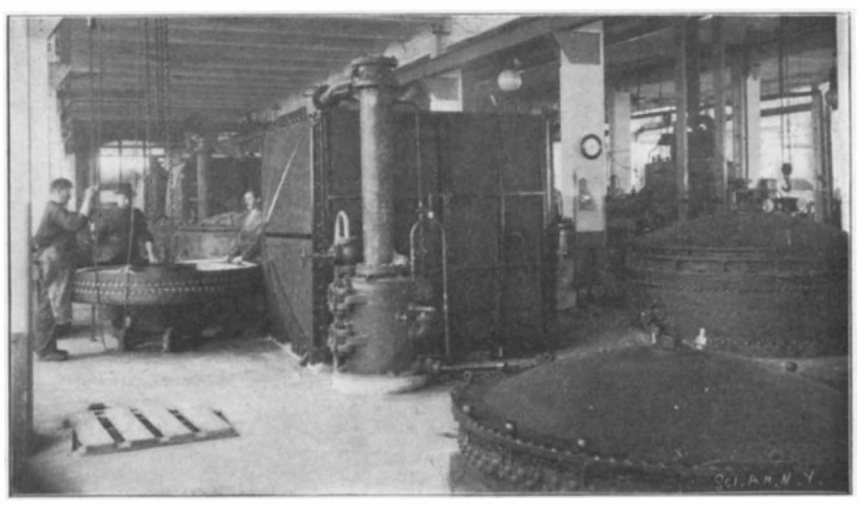
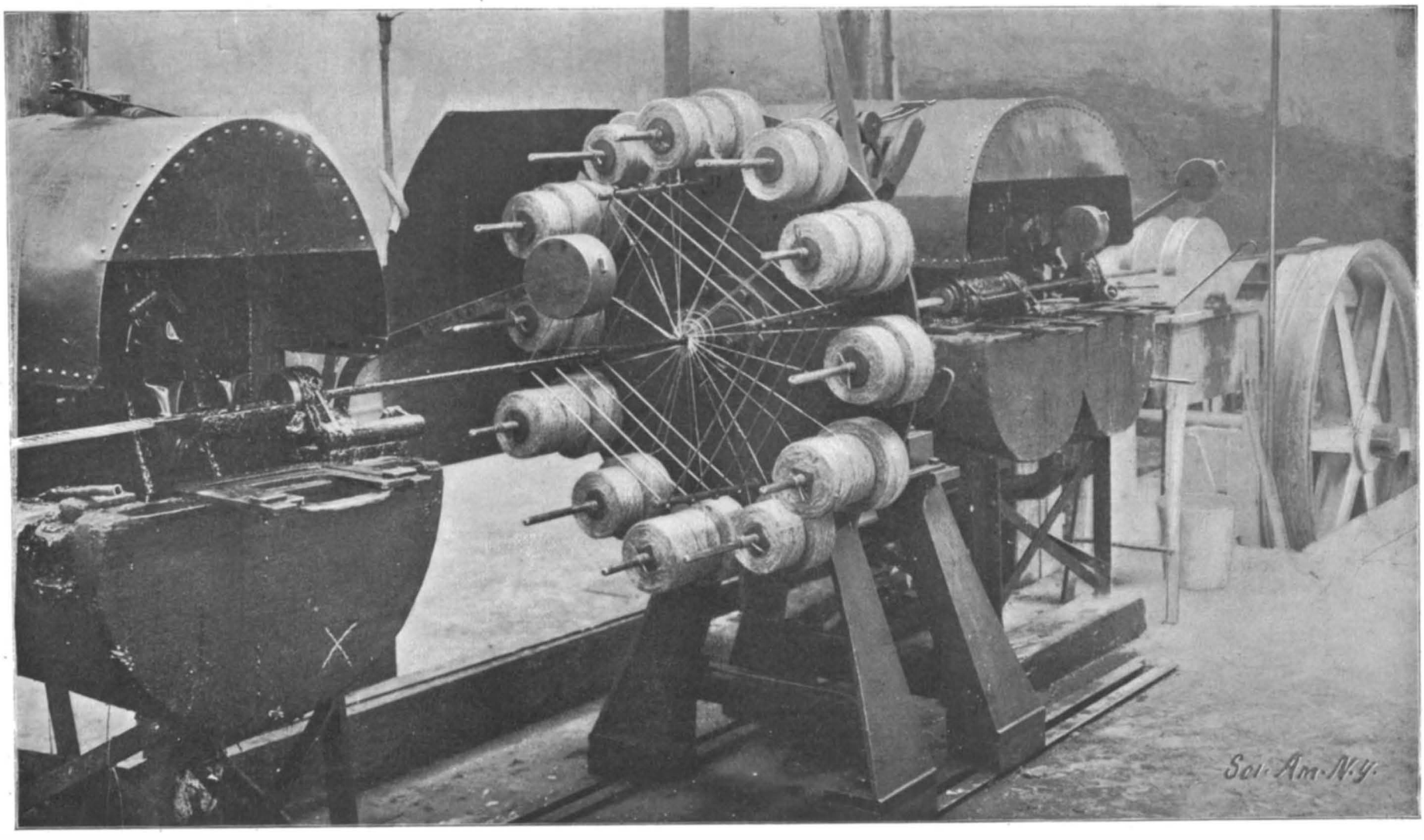
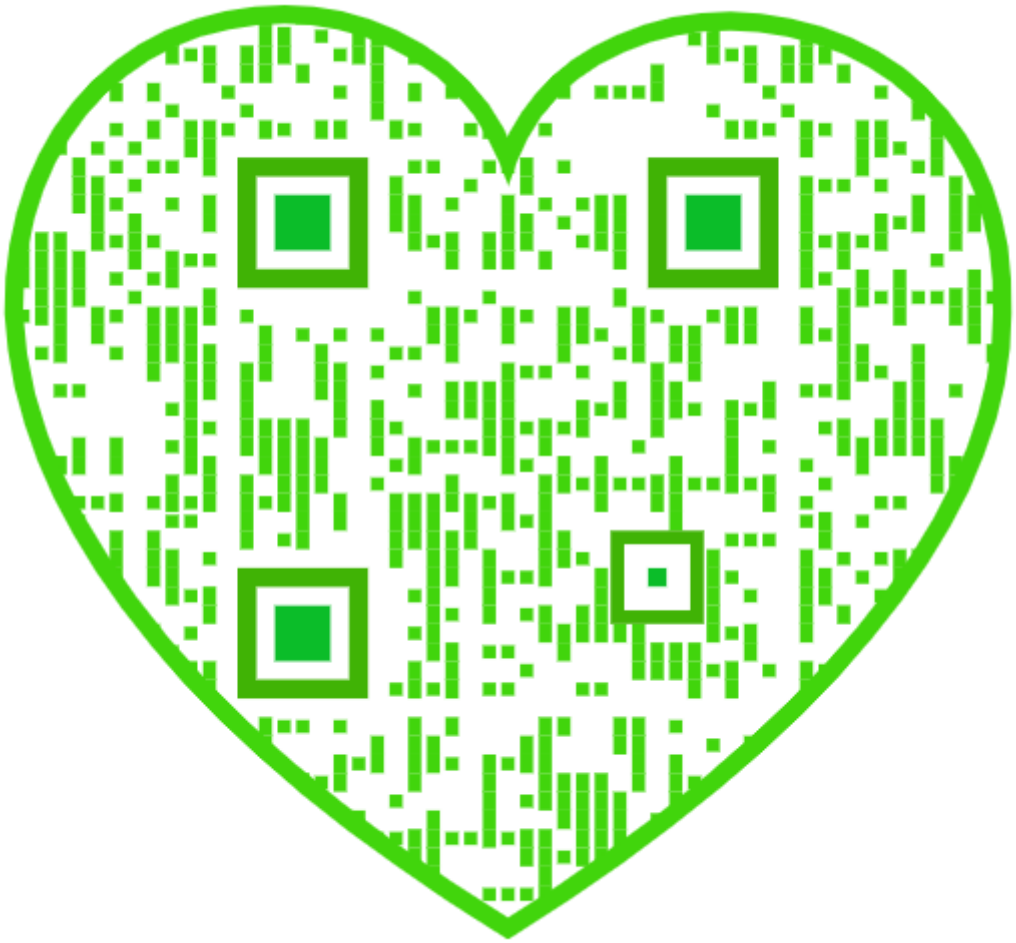


Drying Apparatus.



Final Covering of the Cable with Insulated Fiber.

THE MANUFACTURE OF SUBMARINE CABLES.—[See page 87.]



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NEW YORK, SATURDAY, FEBRUARY 8, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

LESSONS OF THE MURRAY HILL EXPLOSION.

The recent dynamite explosion at Murray Hill, in this city, is one of those unfortunate accidents which, judging from their frequency, seem to be inseparable, at least under existing conditions, from the carrying out of municipal improvements that involve extensive blasting operations in the heart of a busy city. It is certain that accidents due to blasting operations are altogether too frequent, and it is probable that this disaster, like the collision which occurred only a few days earlier in the New York Central tunnel, will lead to a revision of the rules which have been laid down for the protection of life and property, as far as they are affected by this class of work. High explosives, because of their enormous latent energy, are inherently dangerous; for, although by taking the proper precautions, the risk of premature explosion may be reduced to a very low margin, when a disaster does occur, it is liable to be of positively appalling magnitude. On the other hand, unless we are satisfied to see the march of improvement arrested, unless we are prepared, especially on Manhattan Island, to cease the erection of tall buildings calling for deep foundations and put an end to our ever-multiplying schemes for rapid transit and improved communication with outlying territories, we shall have to get accustomed to the knowledge of the fact that dynamite is being carted through our streets, and is being temporarily stored in innocent-looking sheds that are, of necessity, in uncomfortable proximity to the moving throngs and surging traffic of a great city. Although, as we have said, there is an enormous potency for disaster, even in the smaller quantities of high explosives, these substances may be handled and used with perfect safety if only proper rules for storage and manipulation are laid down and rigorously carried out. Cases are extremely rare in the present day in which disastrous explosions of the ordinary blasting agents have been due to chemical decomposition of the agents themselves; almost invariably they are traceable to carelessness or accident in the handling. There is, therefore, no cause for panic on the part of the citizens of New York, or of any other municipality where extensive blasting operations have been carried on. The disaster has shown the necessity for more stringent inspection on the part of the city authorities of the methods of storing and handling high explosives. The lesson for the contractors is that only eternal vigilance can ensure New York against future accidents of the kind during the completion of the subway.

FRAILTY OF TORPEDO BOAT DESTROYERS.

Owing to the innumerable disasters that have overtaken several of the torpedo boat destroyers during the past few months, Sir Edward Reed, the former Chief Designer of the British navy, has urged for a Parliamentary return relative to the character of the tests imposed upon torpedo boat destroyers before the Admiralty finally accepted them, and a report upon the efficiency of this type of war vessel. The government in their return give the names of all the torpedo boat destroyers in the British navy, the dates when they were ordered, and the dates when the boats were accepted by the government, or, in the case of unfinished boats, the expected dates of delivery. Particulars are also furnished of the number of preliminary trials the boats of 30 knots or more undergo, and particulars of typical cases wherein those trials have been exceptional in number, and have been extended over considerable periods.

According to this report, in twenty cases the trials were very protracted, and in several instances the government had to forego their demand for a certain speed, since the boats failed to attain it. The "Albatross," for instance, was ordered in April, 1896, and the trials, numbering seventeen, were spread over a period of six months, chiefly in consequence of alterations made to propellers and other parts of the machinery with the object of reaching the contract speed. The vessel tendered for thirty-two knots, but as she failed to accomplish this speed she was finally accepted at thirty-one and a half knots. The "Express," which has not been taken over by the Admiralty, has already been submitted to no fewer than twenty-seven preliminary and ten official trials, but satisfaction has not yet been obtained. In many cases failure to obtain the required speed has been the cause of the extended trials. Of four thirty-knot boats, one was accepted at twenty-nine knots, and three others at twenty-nine and a quarter knots. One destroyer was tested for six months, after which locomotive boilers gave place to water tube, of which a two months' trial was made, but the boat was finally accepted at twenty-six and three-quarter knots instead of thirty knots. All the new orders since 1900 have required thirty-two knots, but only four of these have been accepted. Altogether sixteen destroyers have yet to be delivered.

The Admiralty has also issued a note of warning to the Admirals in command of the British fleets on foreign stations, urging the more careful usage of destroyers. It is specially pointed out that these frail craft are not fit for the rough work to which they have hitherto been submitted. The Naval Department now directs that they should be treated with more consideration for their structure and capabilities than has heretofore been shown.

SUBTERRANEAN TEMPERATURE.

The driving of the great Simplon tunnel through the Alps is affording some interesting data on the subject of subterranean temperature. The work has progressed in the north heading over 21,000 feet, and in the south heading over 17,000 feet. Temperature observations have been taken both of the rock and the atmosphere. The temperatures of the rock show a steady increase with the depth of penetration in both headings. Thus at 1,640 feet from the portal of the north heading the rock showed a temperature of 54.3 deg. Fah., while in the south heading at the same distance from the portal the temperature was 56.2 degs. At 6,560 feet the temperature in the north heading was 63.6 degs., and in the south heading 69.7 degs. At 12,920 feet from the north heading the temperature was 76.3 degs.; at 15,090 feet it had risen to 86.3 degs., and at 16,400 feet penetration the temperature of the rock was 89.1 degs. The highest temperature recorded previous to September last was 92.2 degs. Fah. Early in October a heavy stream of water was encountered, which temporarily drove the gangs of workmen from the heading and necessitated temporary suspension of work in the main tunnel. The heaviest flow of water recorded at that time was about 200 gallons per second; and while it has been productive of considerable inconvenience in the tunnel work, it brought with it the advantage that it produced a very marked decrease in the temperature of the rock. The temperatures of the air are not given, for the reason that they vary with the amount of ventilation. During the summer it was found necessary to deliver to the northern end of the tunnel 39,000 cubic feet of air, and 66,000 cubic feet to the south end.

THE EAST RIVER BRIDGE FROM THE STANDPOINT OF ART.

Considered from the æsthetic standpoint, the new East River Bridge is destined always to suffer by comparison with its near neighbor, the present New York and Brooklyn suspension bridge. Whatever criticism has been made against the constructive features of the latter structure, it has always been conceded to be an extremely graceful and well-balanced design. It is possible that, were it not in existence, we would not hear so many strictures upon the manifest want of beauty in the later and larger East River Bridge, which is destined to be popular more on account of its size and usefulness than for its graceful lines. As a matter of fact, the East River Bridge is an engineer's bridge pure and simple. The eye may range from anchorage to anchorage, and from pier to finial of the towers, without finding a single detail which suggests any controlling motive, either in its design or fashioning, other than that of bald utility. The bridge is a strain sheet translated most literally into metal. For simple strains of tension or compression the most favorable distribution of metal in the framed portions of a bridge occurs when its members are strictly rectilinear. Speaking in a general way, curved forms, both in the details and in the general sweep of the outline of the bridge (saving, of course, the one great exception of the main cables), while they conduce to the grace and elegance of the structure, almost invariably add to the cost, and, weight for weight, diminish the strength of the structure. Hence, pound for pound of material, a bridge which follows most nearly the simple straight lines of the strain sheet will be the most economical in construction. It will also be the most scientific, the most easy to construct, both as regards shopwork and erection, and, in all probability, the most ugly.

Mr. Gustave Lindenthal, the new Commissioner of Bridges for New York city, and a bridge engineer whose designs are invariably of architectural merit, is stated to have said at a recent meeting of the Municipal Art Society that the towers of the new East River Bridge were the "ugliest possible." While we are scarcely prepared to go so far in condemnation as this, we must confess that we have always regarded these towers as unshapely. The most serious defect, from the architectural standpoint, is the very abrupt angle in the towers at the level of the roadway. The two halves of the tower are vertical to about the level of the roadway, and then incline inwardly at a decided angle, making an awkward and irregular outline which is entirely out of harmony with the curves of the main cable, or the unbroken vertical lines of the approach and the main trusses of the roadway. Mr. Lindenthal would doubtless have designed these towers with symmetrical curves, such as he adopted on his very artistic design of the Hudson River Bridge. Such towers might have been slightly more expensive to build, but the extra cost would have been a small price to pay for the added beauty which would have been given to the whole conception. This is not by any means the first time, as we have already suggested, that the East River Bridge has been criticised for its lack of æsthetic beauty. Some two or three years ago the Hon. Salem H. Wales, at that time a member of the East River Bridge Commission, gave warning that the designers of the bridge were disregarding the æsthetic elements of the problem, and urged that steps should be taken to beautify the towers. It will be a pleasure to some of our older readers to recall the fact that many years ago Mr. Wales was one of the editors and proprietors of the SCIENTIFIC AMERICAN.

RAILWAY WORKMEN AND DISBURSEMENTS.

The growth of our railroads in recent years has been so rapid that they exert an influence on the whole national life scarcely comprehended by outsiders, and politically, financially, and socially they form in the aggregate a factor of far-reaching importance. No other business, except that of agriculture, employs so many men, nor does any other single industry begin to distribute such an amount of money in wages and interest and dividends as the railroads. The combined number of employés of the railroads of the United States is roughly estimated at a million, with some five millions directly dependent upon them. This army of employés includes officials, clerks, engineers, firemen, trainmen, and mechanics and workmen in the shops, stations and general offices, representing the widest range of work. The railroads thus touch upon a dozen different technical and industrial fields, with workmen graded from the unskilled day laborers on the tracks up to the engineers and officers, with their highly technical knowledge and training.

Last year the gross earnings of the railroads of the United States amounted to $1,487,000,000. This enormous amount puts all other industrial corporations or combinations of corporations in the shade. Of this sum, $577,000,000 went to pay for labor that appeared regularly on the pay rolls. The stockholders received as their portion some $118,000,000, while the balance, or some $910,000,000, was needed for rentals, interest, taxes, supplies and material.

In view of these figures collected for 1900, it is interesting to note the disbursing power of this gigantic industry. Over a billion dollars are annually distributed throughout the whole of the country by the railroads in the form of wages, rentals, taxes, interest, and payment for supplies and raw material. A good deal of this money is paid for rolling stock and steel rails, which in turn becomes wages for employés in the mills and shops which turn out these necessary articles of railroad building. In other words, according to a recent authority on railroad matters, the gross earnings of the railroads are distributed as follows: Of every $100 earned by the corporations, $39 go directly to the employés of the road in the form of wages and salaries, $27 for supplies and the labor required to produce them, $23 for interest and rentals, $3 for general taxes, and $8 to the stockholders. The general distribution of the vast gross earnings of the roads is thus so general and over such a wide area that the railroads might well be considered the greatest combined agency for equalizing the general circulation of money in the world.

The disbursement of $577,000,000 a year among the direct and regular employés of the railroads represent a weekly pay roll of about $10,000,000. This would give to each employé, if divided equally, about $11 per week, or $570 per year, for his services. To carry this disbursement further, it will be seen that according to our population, there would be about $75 a year for every person in the country.

The distribution of the money thus collected and earned by the railroads is further shown by the payment of the $910,000,000 for material, supplies, rental, interests and taxes. These supplies include the rolling stock, steel rails, offices, buildings, and innumer-

able other necessities of a railroad plant. The construction of cars employs skilled labor in a score of different branches, and also the manufacturing of steel rails, telegraph wire, and other articles of use. Millions of dollars are thus directly distributed annually in manufacturing lines which are entirely dependent upon the railroads for their existence. The materials used for operating a great railroad are so many and different that it would require a small volume to attempt their classification, and their manufacture is directly responsible to the growth and expansion of the railroads.

Both in respect to their capitalization and the number of men employed, the railroads stand pre-eminently first among our national industries, and it is natural that the highest standard of efficiency and training should have been developed here. The engineers, firemen, mechanics, and trainmen of the railroads of the United States have developed and broadened with the companies they serve. In no other industry is there a better trained class of men. Merit and efficiency have always been the qualities that have led to promotion and financial reward in this department. In self-protection the railroad companies have had to encourage in the men an ambition to serve in the highest and most satisfactory manner. The work of engineers, firemen, switchmen, dispatchers, and operators, as well as that of the directing officers, is of such a character that the gravest responsibilities rest upon them. In no business is the effect of mistakes, carelessness or ignorance of more serious concern. Keeness of mind and intellect, sobriety, and watchfulness are constantly demanded of these employés.

The railroad companies have stimulated their employés to save money and to observe temperance and sobriety. Drinking is almost prohibited in the railroad service. No man who drinks while on duty or just before going on duty could retain his position. An engineer, dispatcher or switchman accustomed to drinking could not long conceal his weakness and be retained. The companies do not lay down prohibitive rules for the sake of the temperance cause, but as a matter of self-protection.

All of his training has a direct bearing on the question of distribution of money throughout the country. The railroad men as a rule save more of their wages than any other employés of a similar grade. A part of their wages is invested in relief societies connected with the railroad companies, and another part in paying for pensions which will keep them in comfort when too old to work. This form of co-operation is encouraged and directly abetted by most of the large railroads. The money thus earned by the roads and distributed among their employés is not, as a rule, wasted and lavishly spent, but it is carefully used and invested to keep the men from future want. Long service in the railroads is further encouraged on some roads by systems of pensions which are granted to those who reach the age of seventy. Thus a man is induced to make railroading a life business and not a mere makeshift, and all his abilities and talents are devoted to the industry.

PRACTICAL VALUE OF NERNST LAMPS.

BY ALTON D. ADAMS.

After three years of labor Nernst lamps have been reduced to commercial form. The object here is to inquire to what extent the qualities of the Nernst lamp fit it to displace the arc and incandescent types. The main points to be considered, in a comparison of this latest lamp with the older types, are adaptation for distribution, size and qualities of the service units and efficiency. In distribution of electric lamps the prevailing methods are the series and the multiple. Series distribution is generally applied to street lighting and requires lamps for each of which the ratio of volts to amperes is as small as possible. Multiple distribution is the rule in commercial lighting, and here a lamp is wanted with a large ratio between its required volts and amperes. The smallest Nernst lamp now offered consumes not less than 88 watts, and the sizes that seem best adapted for general use range from this to 517 watts. A lamp for 88 watts may be had at either the 110 or 220 volt pressure, but the larger sizes are only available for 220 volts. The 88 watt lamp at 110 volts, taking 0.8 ampere, has a ratio of required volts to amperes of 137. On a series circuit of 3,000 volts maximum pressure only 27 of these lamps may be operated, giving a total capacity of 2,376 watts. Incandescent lamps for such a circuit may be readily had, each of which requires 6 amperes at 15 volts, or 90 watts, so that the ratio of volts to amperes for each lamp is only 2.5 instead of 137, as in the Nernst lamp. Of these incandescent lamps 200 may be operated on a circuit of 3,000 volts maximum pressure, and the capacity of this circuit will then be 18,000 watts, or almost seven times that of a series circuit of like pressure with Nernst lamps of equal watt consumption. If larger units of illumination are wanted, a Nernst lamp taking 517 watts in the form of 2.35 amperes at 220 volts may be compared with an inclosed arc lamp taking 6 amperes at 85 volts, or 510 watts. For this Nernst lamp the ratio of volts to amperes is 93, and for the arc lamp the like ratio is only 14. On a series circuit of maximum 3,000 volts' pressure 13 of these Nernst lamps may be operated, giving the circuit a capacity of 6,721 watts. The inclosed arc lamps on a similar circuit may number 35 with an aggregate capacity of 17,850 watts. From the foregoing it appears that if 88-watt Nernst lamps are used the number of circuits must be seven times as great as if incandescent lamps using an equal amount of energy each are employed. If resort is had to Nernst lamps of 517 watts each the number of series circuits to distribute a given amount of energy must be 2.6 times as great as where inclosed arc lamps of equal watts are employed. It seems improbable that in street lighting either the advantage of series distribution will be given up or the large increase in the number of circuits just indicated be made for the sake of using Nernst lamps. For multiple distribution it is desirable to have a high ratio of required volts to amperes at each lamp. In this particular Nernst lamps are superior to arcs, but are on a par with the incandescent, since the latter are regularly made for the pressure of 220 volts. Taking the pressure for multiple inclosed arc lamps to be 110 volts, because of the necessary resistance to insure steady operation, it seems that when the Nernst and arc lamps require equal watts the weight of copper necessary to distribute the former at 220 volts is only one-fourth of the like weight for the latter. The great bulk of commercial incandescent lighting is done with 16-candle power lamps, because a lamp of this capacity gives better distribution of illumination for general purposes than larger sizes, and has been found ample for individual use at the work bench or desk. The smallest Nernst lamp offered consumes 88 watts, or 1.76 times as much energy as the 16-candle incandescent lamp using 50 watts. It has generally been found in practice that each workman in the counting room or shop must be supplied with a lamp for his individual use, so that the adoption of Nernst lamps for these purposes must increase the required capacities of dynamos and circuits by 77 per cent. This Nernst lamp using 88 watts yields more than 16-candle power, but incandescent lamps of any candle power up to several hundred have long been available. A large part of electrical distribution at the present time is carried out with direct current, and the important functions of storage batteries furnish strong reasons for continued practice in this direction, as do also the great investments in direct-current systems. The application of Nernst lamps in direct-current circuits encounters the serious objection that a black deposit gradually spreads from the negative toward the positive end of the glower and cuts down the candle power. In the matter of first cost the Nernst seems to be at a decided disadvantage compared with the incandescent lamp. Six dollars is reported to be the price of an 88-watt Nernst lamp, and this sum is about twenty times that of an incandescent lamp of equal wattage. The Nernst glowers must be renewed like incandescent lamps, and while the price of glowers is not at hand it seems fair to presume that the cost of their renewal will be as much as that of incandescent lamps that consume equal energy. Considering the remainder of the Nernst lamp, aside from the glowers, it seems that the rate of depreciation can hardly amount to less than 10 per cent of the first cost per annum. Interest at 6 per cent plus this depreciation brings the fixed yearly charge per lamp to 96 cents. If lamps operate 1,000 hours yearly and renewals are every 500 hours at equal cost of 30 cents for the incandescent and Nernst, then the renewals, interest and depreciation on the latter amount to 2.6 times the renewals of the former. The Nernst lamp taking 517 watts is said to cost $15, or about eight times as much as a group of six incandescent lamps of equal energy capacity. An inclosed arc lamp with a capacity of 500 watts costs approximately the sum just named for the Nernst lamp of that rating, and it is fair to assume that renewals, interest and depreciation on these two will not be far apart. In required cleaning and care in operation the Nernst appears fully up to the inclosed arc lamp.

The Nernst glower operates at a temperature between that of the incandescent filament and of the electric arc, and, as might be expected, the quality of light obtained is mediate between the other two sources. It thus seems that for some purposes the Nernst is superior to incandescent lamps, though not necessarily so much superior as are arcs. The claim urged as most important for Nernst lamps is that of high efficiency, and this deserves to be examined with some care. Complete data as to efficiency is available for only that size of Nernst lamp that consumes energy at the rate of 517 watts, and it is admitted that the 88-watt lamp has a somewhat lower efficiency. According to the figures published by its makers the best result obtainable with the 517-watt Nernst lamp is 149 mean spherical candle power in Hefner units. This corresponds to an efficiency of 3.47 watts per candle power. Measured in this same unit, either direct or alternating arcs of the inclosed type with clear outer globes yield a candle power for every 2.6 watts drawn from 110-volt constant-pressure mains. When these arcs are used on series circuits, so as to avoid the losses in steadying resistance, the rate of energy consumption falls to 2 watts per mean spherical candle. Incandescent lamps may commonly be had at either 3 or 3.5 watts per mean spherical candle power, the higher efficiency going with a shorter life.

In view of the foregoing the following conclusions may be reached as to the practical value of Nernst lamps: For street lighting the Nernst is not generally suited, because it is impracticable to operate it on series circuits, and because its efficiency is materially below that of series arcs. For divided indoor lighting Nernst lamps are less suitable than incandescent, because of the larger first cost, fixed charges and energy consumption of the former in the smallest units. Where large interior spaces are to have general illumination the Nernst lamp has some advantage over the incandescent in the quality of its light, and over the arc in the weight of conductors necessary. This advantage over arcs seems to be fully offset by the lower Nernst efficiency.

SCIENCE NOTES.

The King of Italy has conferred upon Signor Marconi the decoration of the order of St. Lourice and St. Lazarus.

The exploring vessel "Discovery," which has recently left New Zealand for the Antarctic, is quite unfit to proceed on her journey. She not only rolled badly, but also rocked. Her officers, however, profess confidence in the ship.

The shower bath has proved very successful in Public School No. 1, New York city. Its capacity is sufficient to bathe 150 to 200 boys per day. Fifteen minutes are allowed for the bath, including dressing and undressing.

The Pan-American Exposition Company is so deeply embarrassed financially that exhibitors will probably have to pay for the diplomas themselves. About 10,000 are to be issued, and the total expense will be $3,000, and this sum the company is unable to meet.

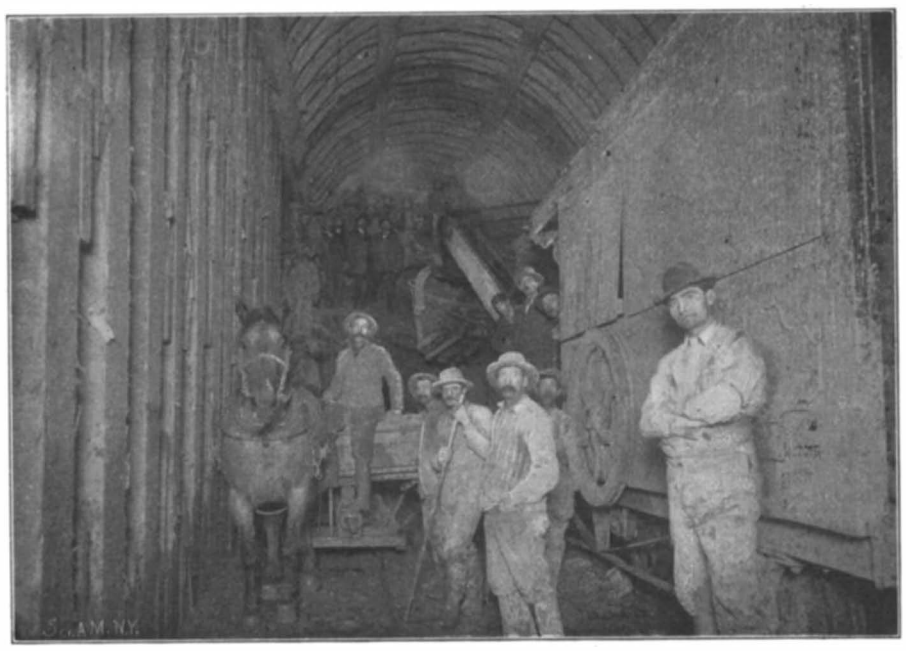
At a dinner of the new Aero Club of the United Kingdom, held in honor of M. Santos-Dumont, the latter stated that next summer, after his aerial trip from France to Corsica, he would return and make some trials of a steerable airship above London.

The Egyptian Exploration Fund has accomplished remarkable results in connection with the operations at Abydos. During the past year the association has completed the most important historical work that has ever come into its hands. The continuous order of seventeen kings has been established, and the foundations of Egyptian history have been settled in a manner that had hitherto been deemed beyond hope. The excavations at Abydos have provided the only contemporary history of the time, and completely vindicated the historical character of the lists which had been preserved by later ages. The historic character of Mena is substantiated, and the long line of a dozen kings back to Mena is rendered clear. The Egyptologists have seen and handled the gold, the crystal, the ivory with his name and engravings; and even kings that went before him are now better known by actual objects than one-half of the Saxon kings of England. No such complete materialization of history has ever before been obtained at one stroke from any other country or age. There remains to be examined at Abydos the great temple site, one of the most ancient and promising spots in that land of buried treasures.

The work of raising the Great Monolith at Stonehenge, England, has enabled archæologists to form a more reliable estimate regarding the epoch in which these druidical monuments were erected. There has hitherto been much controversy on this point, certain authorities clinging to the assertion that it was built in Roman times, while others contend that it was erected during the bronze period. While making excavations round the monolith for the concrete bedding, a large number of neolithic stone implements were unearthed that show every sign of having been used to cut and to square the stones. They all bore marks of hard working, and when of no further use for cutting, the stones had been apparently thrown aside and afterward used to make a bedding to support the uprights. Experts therefore now entertain little doubt that Stonehenge was built in the neolithic age, for had it been built in the bronze or iron age, bronze or iron tools would have been used. Although leading authorities do not quite agree as to the actual date of the introduction of bronze into Britain, it is generally conceded to have been about 1500 B. C. It is consequently apparent that Stonehenge must have been constructed at some period considerably previous to that date.

CONSTRUCTION OF THE ASPEN TUNNEL.

One of the most important sections in the work of reconstructing the Union Pacific Railroad in Wyoming was the excavation of what is known as the Aspen Tunnel. The Leroy-to-Bear River cut-off location crosses the Aspen ridge, one of the foothills of the Wasatch ridge, which it was necessary to tunnel. By making open cuttings at each side of the ridge, the actual length of the tunnel was brought down to 5,900 feet. The approach to the eastern end of the tunnel is through a heavy cut 2,200 feet in length, and at the western approach is another cut 2,600 feet long. The work commenced late in 1899 by the sinking of a shaft about 3,000 feet from the eastern end, which was carried down to a depth of 331 feet, where it reached the level of the tunnel floor. Headings were then pushed out in each direction to meet the headings driven from the ends of the tunnel. Shortly after a start had been made with the headings from the central shaft, there was a heavy inflow of water which rose to a height of 70 feet above the bottom of the shaft. After being flooded for eight or nine months, the shaft was pumped clear of water and the driving of the headings resumed. The material from the eastern approach cut totaled 260,000 cubic yards, while 185,000 yards were taken out of the western approach. The drilling in the tunnel was done by compressed air machinery, and one of our illustrations shows a steam shovel at work in the tunnel, operated, however, not by steam, but by compressed air. These shovels were used for loading material blasted out of the benches in the rear of the headings into dump carts. The dipper has a capacity of three-fourths of a cubic yard and the height of the boom is 16 feet.



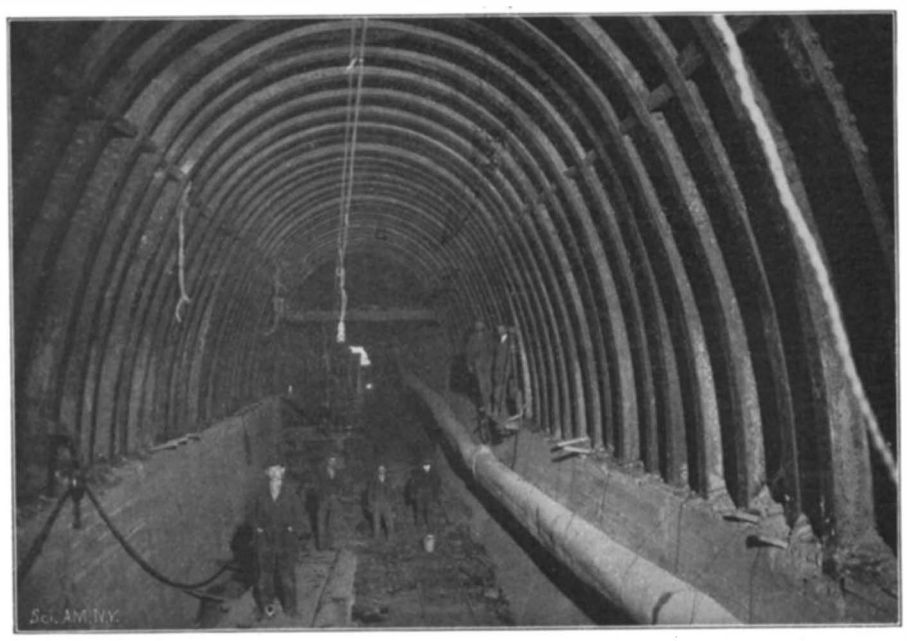
West End Shovel Taking up Muck from Bench.

The greater part of the length of the tunnel was lined with timber, the walls consisting of vertical 12 x 12 posts, spaced from 20 to 6 inches or less in the clear, according to the nature of the material encountered. The roof was timbered with arched ribs built up of three pieces of 4 x 12-inch plank in segmental form, as shown in the accompanying illustration of the steam shovel. In some parts of the tunnel, where the material was particularly soft, the built-up ribs were placed solid, or touching one another. After the timber lining had been used for a distance of 600 feet from the western entrance, there began to be a sliding movement of the material both from above and from the side. Huge masses of rock moved at the rate of about 1 foot per week, and the pressure was so great that the heavy timbers and ribs were crushed and broken. For a distance of over 700 feet all the timbering had to be removed, and a lining of concrete and steel put in its place. This construction was made up of steel framework and concrete filling; the frames consisting of 12-inch I-beams, weighing 55 pounds per foot, spaced from 24 inches to 12 inches center to center. They were built in three sections, the top being bent to a circular curve and the side members to a curve of a longer radius. The three sections were spliced together and each formed a complete horseshoe. The space between the steel ribs and for a depth of 6 inches outside the ribs was filled in with concrete, lagging being placed at the back.

The accompanying photograph shows the steel ribs in place and the concrete filling built up to a height of 5 or 6 feet above the floor of the tunnel. Another of our illustrations shows the effect of the side and roof pressure of the sliding rock on the steel ribs. In this particular case the movement of the rock was too rapid to allow of the concrete to be set in place, and distortion of the steel ribs occurred. The upward pressure against the floor of the tunnel was resisted by laying a bed of concrete, 5½ feet in depth, which was stiffened by a layer of rails imbedded in the concrete with their axis crosswise to the axis of the tunnel. The cause of the heavy pressure and the movement of the rock is ascribed to different causes, one authority considering it to be caused by swelling of the soft shale rock due to oxidation on its being exposed to the atmosphere, and another authority considering that it is due to the direct pressure of the overlying material.

Heavy Steel I-Beams Yielding Under Pressure of Slacking Material.

CONSTRUCTION OF THE ASPEN TUNNEL.



Arched Steel Ribs in Place, with First Lift of Concrete Laid.

The History of the Spur.

Not many horsemen are aware of the fact that the spur which they attach to their heels is an instrument the origin of which is lost in the most remote antiquity. The Romans were familiar with the use of the spur; they called it Calcar (cock's spur). No doubt this name was derived from the original shape of the spur, which was probably nothing more or less than a long point.

During the middle ages, the wearing of the spur was regarded as a sign of freedom. The vassal to whose heel it was fastened swore fidelity to his suzerain. The wearing of spurs soon spread to such an extent that even the clergy followed the fashion set by the knights. But this custom did not long endure; at a council of nobles and bishops held in 816, the clergy were forbidden to wear spurs. The spurs of knights were of gold, to distinguish them from the spurs of esquires, which were of silver.

At the beginning of the XI. century when a man, for some noble deed, was dubbed a knight, the ceremony of knighting him began by giving him a pair of spurs. The over-lord in conferring the title attached the spurs himself to the heels of the newly created noble and then gave him his helmet, his horse, his sword and his lance.

The oldest known form of the spur is that of a long pin or needle. This early specimen was found at Autun, in the tomb of Queen Brunehaut, murdered by her rival Fredegonde in 613.

In the 13th century spurs received the form of rosettes or stars. The wheel-form did not appear until the 15th century. Most of the young noblemen of that day wore spurs of most curious pattern, comprising primarily a rod half a foot long, at the end of which an enormous star-wheel was carried. In the middle ages, when a cavalier almost stood in his stirrups and horses were caparisoned, very long spur-shanks were necessary in order to reach the flanks of the mount. A specimen of this type of spur has been preserved, and its ownership ascribed to Godefroy de Bouillon, who died in 1110.

In the 18th century, when the knight of old had practically disappeared, M. François Robicon de la Guermièhe, Equerry to His Majesty Louis XIV., was the first to cut down the length of the shank and give the spur its modern form (1768).

Balloon Outfit of the Sultan of Morocco.

The Sultan of Morocco, Muley Abdel Azis, is having a captive balloon and its accessories constructed by Schneider and Company, of Creusot. The outfit includes all the material necessary for furnishing the new aerostatic park which the Sultan has in project, and M. Edouard Surcouf, the well-known Paris aeronaut, is to superintend its installation. The outfit is of the first quality, and has a number of improvements. The balloon is made of a specially prepared silk tissue and is claimed to be absolutely tight. It has a volume of 1,000 cubic yards and is kept swelled out by a small air balloon in the interior gaging 90 cubic yards. When filled with hydrogen the balloon will lift three persons to the extremity of its cable, which is about 2,000 feet long. The car, built on the Hervé system, is a model of elegance and comfort; it has a telephone post which communicates with the ground. The steam windlass has been well designed and the cable is unrolled in a uniform manner. It is operated by two controlling levers. A ventilating fan is used to keep the interior air-bag filled out. The retaining cable is attached to the car by a pulley mounted upon a flexible joint to give it the proper direction. A hydrogen generator has not been provided, as the balloon will be filled from tubes of compressed gas. It is estimated that it will take 120 tubes of a capacity of 25 gallons, charged at 1,900 pounds per square inch. The hydrogen is produced by electrolysis at the Montbard works and is thus chemically pure. Every time the balloon is filled the tubes will have to be returned to France, where they will be re-charged and sent back to Morocco. This process is quite expensive, but no doubt the Sultan can afford it.

In response to Sir Harry Johnston's appeal for the protection of the okapi, to prevent its extermination by big game hunters, the British government has placed this animal on the list of wholly protected animals in the Game Regulations of the Uganda Protectorate. By this decree, any person shooting or trapping the okapi in British territory, except by the written permission of the commissioner of the Uganda Protectorate, commits an illegal act. It is hoped that the Belgian authorities will co-operate with the British authorities in preserving this newly discovered and rare animal by passing a similar law in connection with the Congo forests.

THE MANUFACTURE OF SUBMARINE CABLES.

The new cable-works of Siemens & Halske, probably the best equipped of their kind in the world, were opened August 1, 1899, and have since been in constant operation. Goods are brought to the works by water as well as by railway. For this purpose a canal has been cut which extends from the river Spree to the factory. Railway traffic between the freight depot and the works is effected by a steam ferryboat which transports at once two railway cars. The cable-works are built on piles and consist of a horse-shoe-shaped structure, the inner, open courtyard of which contains a number of extensive halls connected with all parts of the lower story. The workshops, sample-rooms, and offices are so arranged that the workmen can readily pass from one into the other, which arrangement is specially valuable in cable-works, since the transport of half-finished cables over an open court, exposed to the weather, is thereby avoided.

The process of manufacture proceeds from north to south. Each division may in itself be considered a small cable plant of its own. The entire cable-works are chiefly used for the manufacture of lead-covered fiber cables. In addition, the gutta-percha and rubber-covered cables, as well as double-insulated telephone cables, are made in the main building. Covered and braided wires of different kinds for installation purposes, and for the building of machines and electrical purposes are produced in large quantities.

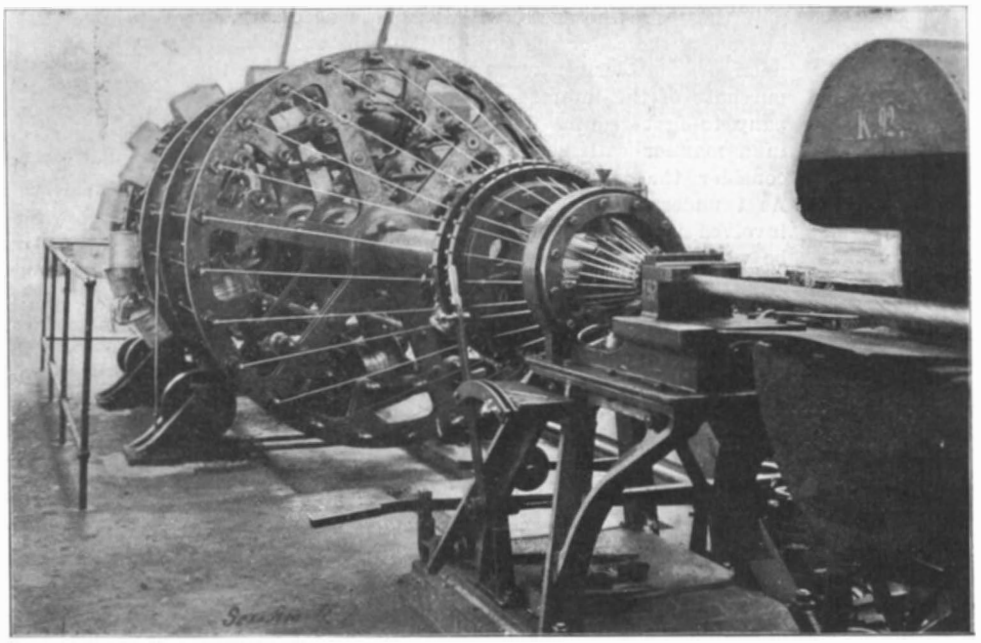
The Braiding Machines.

Manufacture of Heavy Cables.—After the wire has been weighed out in the storerooms, it is taken to the wire-winding drum and there reeled on coils, which are called bobbins and which fit into the cable-machine. In the stranding-room the copper wires are united on the cable-stranding machines and finally covered with insulating material, jute being usually employed.

Adjoining the stranding department are the impregnating and lead-pressing room, situated in the middle of the halls constituting the plant. Here the jute-covered cables are freed from all moisture in vacuum drying-boxes, and are then thoroughly impregnated with insulating material in large kettles. In the background of one of our illustrations, the vacuum-boxes are seen; in the foreground the impregnating-kettles are pictured.

From the kettles, the impregnated cables are transferred to the lead-press and covered with a seamless lead jacket. The lead may be either warmed sufficiently to attain a certain degree of plasticity, or may be pressed about the cable wires while cold, but under considerable pressure. When the cable has been thus covered with lead, a careful test is made to determine whether insulation is complete and effective. It is the primary purpose, however, thoroughly to ascertain whether or not the lead covering is absolutely air-tight; for the entrance of moisture into the insulating fiber would produce disastrous results.

A cable which has satisfactorily withstood the insulation test is now taken to the armaturing department and is there wound with iron wire or enveloped with an iron mantle. In one of our front page illustrations a machine is shown, the purpose of which is to wind this protecting wire jacket around the cable. Upon this protective envelop fiber is spun which is then impregnated with an insulating material. It is the purpose of this insulated-fiber covering to protect the armature from the damaging influence of the earth wherein the cable is to be placed. The fiber-winding machine is illustrated. The cable, after having been finally drawn through a bath of lime-water, the purpose of which is to destroy the adhesiveness of the impregnated fiber, is wound upon large wooden drums and is then transferred to the southern end of the building ready for shipment.



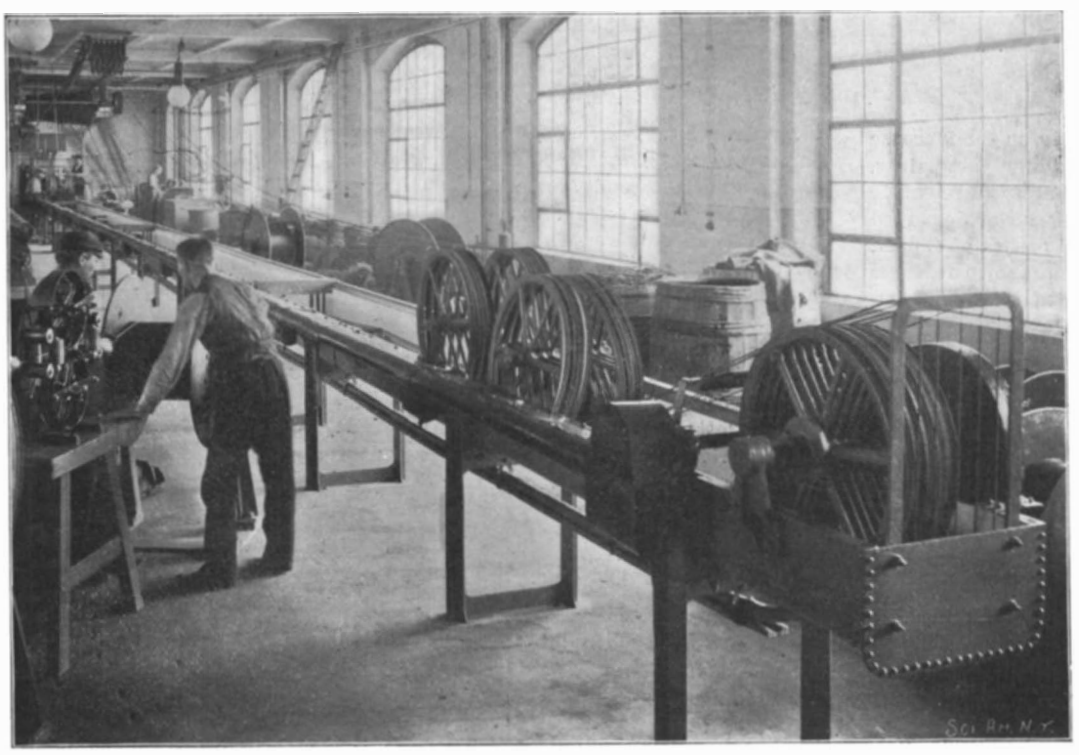
Armaturing Machine.

It will be observed from the picture reproduced that the bobbins on two of the winding-machines, the first and the last, are mounted in different positions. The bobbins of the stranding machine have what may be termed a planet-motion, or in other words, preserve the same axial relation to a cable at all times. By reason of this arrangement, twisting of the individual wires forming the core of the cable is effected. In winding the armature, which consists of flat wires, the cross section of the wires prevent such a disposal of the bobbins. For that reason the bobbins in the armaturing machine are rigidly mounted. The steel band outer jacket, which is wound upon some cables, serves the primary purpose of protecting the interior windings from mechanical injuries. The wire jacket, on the other hand, is used upon cables which are subjected to some tractive force. Subfluvial cables are subjected to a double winding of protective wire, for they are liable to be injured by ships' anchors.

Manufacture of Spun and Braided Wires.—In the main buildings spun and braided wires are manufactured. As an insulating material, silk and cotton are used. We have shown a spinning machine, which serves the purpose of winding insulating fiber upon dynamo wires. The braiding-machines cover the wire with a hose-like casing, and operate much in the same manner as knitting machines. By a combination of spinning or braiding and by impregnating the fiber with insulating material various qualities and kinds of cable are produced. Conductors which are subject to wear or to certain mechanical influences which may injure them, are covered by the braiding-machine with fine steel wire. Street-railway cables which serve the purpose of connecting the motors with the line conductors require no such highly-efficient protection, and are, therefore, covered merely with the outer envelop of braided fiber. Certain kinds of cables are braided with an insulating material which is impregnated with a fireproofing liquid. It has been found that in certain installations, the insulation of short-circuited cables is easily ignited, and that soon the entire fibrous covering of a cable is burnt off. The fireproofed cable, on the other hand, would prevent the spreading of the flame.

Besides the braiding-machine, the stranding-machines should be particularly mentioned; for by their means a core of flexible conductors is wound upon the finest of copper wires.

The Manufacture of Gutta-Percha and Rubber Cables.—In the making of a gutta-percha cable, it is first necessary to prepare the gutta percha. For this purpose the heated material is kneaded by a special machine until it becomes plastic. The softened gutta percha is then transferred to a press resembling the lead press previously mentioned. By the use of suitable nozzles, the gutta percha is pressed around the wire in the form of a seamless jacket. One of our illustrations pictures a machine of this character. The wires, which have been provided with their jacket by the apparatus in the background, are then passed over rollers partly through the open air and partly through a long trough containing water, the purpose of which is to harden the gutta percha.



Gutta-Percha Press.

THE MANUFACTURE OF SUBMARINE CABLES.

The costliness of gutta percha has been the chief reason for the utilization of rubber compounds, and especially of India rubber. If India rubber be used, vulcanization is necessary. For this purpose the rubber is kneaded together with sulphur or some sulphur-containing substance, which, by proper heating, combines with the rubber to deprive it of its adhesive properties and impart to the manufactured rubber many of the valuable qualities of gutta percha. Like the gutta-percha cables, the India-rubber-covered conductors are made by pressing the material around the wires in a seamless envelop. Sometimes the wires

are laid between two rubber strips, which are then rolled around the wire by a special machine into the form of a jacket. Certain kinds of cables are covered with rubber bands, very much as in the case of silk or other spun cables. After the conductors have received their rubber or gutta-percha protective casing, they are further covered with spun or braided material, or by a pressed mold of lead, depending upon the particular use to which they are to be placed.

Manufacture of Paper-Covered Cables.—Telephone cables are made on the principle that the capacity, even for great lengths, is to remain as low as possible. For this purpose an insulating material with the least dielectric constant is chosen. Dried paper has been found especially suitable. Telephone cables are, therefore, covered by a ribbon of paper reeled from a roll carried by a winding-machine. The cables after having been wound with paper are transferred to stranding-machines and there spun into multiple cables. A moisture-proof covering of lead, and, perhaps, an outer protective wire jacket, complete the cable.

Mortality Rate in the United States.

The statistics recently published by the Census Bureau of this country with regard to the death-rates are of exceptional interest, and are of a nature to give rise to hopeful views regarding the checking of the spread of disease, and perhaps even the extinction of some maladies, says the Medical Record.

The mortality rates given in the bulletin are those for 1890 and 1900, and the comparison between the death list of these periods shows conclusively that the efforts made by hygienists to lengthen the lives of American citizens have been attended with complete success.

The statement is made that the proportion of deaths to population has decreased within the dates mentioned by nearly 10 per cent, and that the average age at death of an American is now 38.2 years, as compared with 31.1 in 1890. This, of course, is a magnificent showing, and the only drawback to the picture is that the bettered conditions of living apply only to the larger cities. The country districts exhibit according to the bulletin no such relative improvement.

The most striking feature of the reports is the great reduction in the death rate from tuberculosis, which has fallen from 245.4 per 10,000 persons in 1890 to 190.5 per 10,000 in 1900, a gratifying proof of the efficacy of modern sanitation, and of the means now employed in fighting the disease. Diphtheria, cholera infantum, bronchitis, diarrhœa, and typhoid fever, also, for the same reasons, claim far fewer victims at the present time than in 1890, the decrease in mortality from these causes having been substantial and progressively steady.

On the other hand, pneumonia, as a factor in the death rate, occupies a more prominent position, there having been 191.9 per 10,000 deaths in 1900, and 186.9 per 10,000 in 1890. The cause of this increase in the occurrence of pneumonia has been on many occasions given in the Record and in other medical journals as undoubtedly due to influenza. This insidious malady has made rapid progress since 1890. In that year, the deaths directly attributed to it were, the census bulletin states, 6.2 per 10,000, while in 1900 the number was 23.9 per 10,000. The fact must also be taken into consideration that influenza peculiarly predisposes its victims to other diseases, notably to pneumonia, by rendering the system susceptible in a high degree to the ingress of disease germs.

Pneumonia as a sequel to influenza is also a most fertile cause of death, the vitality of the patient when seized being at a low ebb, and recuperative powers well-nigh used up by the drain put upon them by the former affection.

Cancer, again, has been conspicuously on the increase during the past ten years, as have kidney complaints, heart affection, and apoplexy. The activity of scientific men in different parts of the world, who are engaged in the investigation of the origin and causes of cancer, give rise to the hope that some of its unknown features may soon be definitely solved, and that, as a consequence, its treatment may be conducted upon more intelligent preventive and curative principles.

The bulletin of the United States Census Bureau is a most satisfactory document, and the tale it tells is a feather in the cap of our city boards of health, and of our municipal reformers generally. There is yet, however, room for much improvement in the sanitary conditions of the large cities of America, particularly in the direction of wholesome dwellings for the poor.

A special train was recently used by President Cassatt on the Pennsylvania Railroad for the inspection of the lines west of Pittsburg. The train was equipped with a telephone service so arranged that communication could be had with each car on the train without the necessity of traveling from one car to another, says The Railway and Engineering Review.

Correspondence.

The Canal Problem.

To the Editor of the Scientific American:

I have read, with a great deal of interest, the various articles in your valuable paper of the 18th instant, bearing on the leading question of the day, viz., the canal from the Gulf of Mexico to the Pacific Ocean; and, as far as your explanation goes, would prefer the route across the Isthmus of Panama rather than at Nicaragua, but I wish to inquire if you have not omitted to mention two very important matters?

In the first place, is not the grant from Colombia to the present canal company only temporary, giving to the company the use and control of the canal for 99 years from and after its completion, when all right, title and interest in it will pass to Colombia in perpetuity? If such is the case, will not the same rule apply to the United States as the successor of the Panama Canal Company? And will that be a satisfactory condition to the people of this country in which to place this nation? Or is it not the almost universal feeling here that the United States, if it advances the money to build the canal, should be the exclusive and perpetual owner and manager of the same, allowing vessels of all nations to pass through in the interest of commerce, but reserving the exclusive control and management, especially in case of war in which this country might happen to be involved?

The other point I desire to mention is that of the French or other bondholders and stockholders who, I believe, hold bonds and stocks to the extent of about $300,000,000, and whose interests, as I understand, will not be settled or satisfied by the payment of the $40,000,000 demanded by the canal company, and who will consequently claim, or can claim, the payment of their bonds or stocks, provided any party of sufficient responsibility should become the owner of the canal.

If these are the facts, will it not be necessary, or at least wisdom, for the United States before entering upon or considering any proposition leading to the purchase of the interests of the Panama Canal Company to first require that these questions be settled in a manner satisfactory to this country, and then consider the advisability of making the purchase? As I understand it, no questions of this nature are involved in the Nicaragua route, and the point will be which route presents the least objections together with the most advantages, not only in a financial way, but also in all other ways which might be presented?

If the statements, as given, are correct, will they not have much bearing on the case when taken in connection with the statements in the articles in your paper? C. E. Gillespie.

Edwardsville, Ill., January 22, 1902.

[The Colombian government, to assist the transfer of the Panama property, has waived the prohibitions under the 99-year lease, and has offered the United States absolute control over a strip, five miles wide, along the route of the Panama Canal, the term of lease to be 200 years, with the right of renewal. After the old company failed its property passed into the hands of a liquidator (equivalent to our receiver) and the interests of the old company, which called for the payment of 60 per cent of the profits of the new company, are still under the care of the liquidator, who has agreed to the proposition to sell the Panama properties to the United States for $40,000,000.—Ed.]

The Armament of Our New Warships.

To the Editor of the Scientific American:

Your special naval number suggests certain reflections on the progress of our navy and the direction in which it is developing of a somewhat pessimistic character. Heavy armament in proportion to displacement has characterized the American navy from its earliest days, and our naval constructors appear to be adhering faithfully to this tradition. The gun power of our new vessels is all that can be desired, but are we not sacrificing defensive strength to a dangerous degree in order to obtain this offensive power? What may have been a wise policy in the days of wooden sailing vessels may well be a very foolish policy in the day of steam-driven ironclads.

The "Georgia" class may fairly be taken as a type of the latest development of the heavy battleship, the ideal fighting craft of our naval constructors. Now, it is clear from your description of this class:

1. That its belt armor is not thick enough to resist a 12-inch shell which has traveled two miles—a greater distance than that at which naval battles are expected to be fought. Even an 8-inch shell would penetrate it at 2,000 yards.

2. The same remark applies to the armor of barbettes and turrets.

3. It is also true that the casemate armor would be penetrated at two miles by the projectiles from guns of the same caliber as those which it is supposed to shield.

It is obvious that a battle between one of these vessels and another of equal strength would be determined either by a lucky shot penetrating the belt armor and disabling the motive power or by the successive disabling of the guns and the destruction of their crews—the armor of the gun positions being too thin to protect them from the fire of any but the secondary batteries; and both vessels would likely be damaged beyond repair, at least as long as that war lasted.

Is it not possible for our naval constructors to devise a more efficient fighting machine by increasing its powers of resistance? Our earlier battleships had armor 18 inches thick on belt and turret, and were built to resist guns of much less power than the gun of to-day. Krupp plates, it is true, are 25 per cent stronger than the Harvey plates, but the attacking gun has increased in power even more. If armor is of any value at all it would seem obvious that it should increase in thickness as the gun increased in penetration; if not, it had better be discarded and the weight put into additional guns.

The nation that will ultimately be victorious on the sea (if the victory is attained by the gun and not by submarines and other devilish novelties) will be the one that first appreciates the fact that one gun behind a shield that cannot be penetrated, on a vessel that cannot be sunk or crippled in its motive power, is more effective than a dozen which are imperfectly protected on a vessel which can be rendered helpless by a single lucky shot.

To illustrate, let a vessel of the type of the "Georgia" be opposed to one of equal displacement but one deck less in height. Raze the double turret of the "Georgia," discard all its 8-inch guns and half of its 6-inch and smaller guns and put the weight so saved into heavy armor, say, 18 inches for barbette and turret, 8 inches or 9 inches for casemate and 20 inches for belt armor. Such a vessel could be pounded all day by the "Georgia" without serious injury, while every shot it sent could go through the "Georgia's" casemates, and every 12-inch shell could penetrate turret, barbette and belt. Can there be any doubt as to the outcome of such a fight?

It is no answer to say that other nations are sacrificing defensive to offensive power in the same way that we are. While we were learning to build ships of war it was well enough to follow foreign models, even copying their errors. We have learned all they know and ought by this time to be improving on their methods, and no greater improvement can be made than to construct vessels that cannot be sunk and arm them with guns that are nearly, if not quite, proof against attack. T. W. Brown.

Chicago, December 30, 1901.

[Our correspondent's argument in favor of heavier armor would have more weight if it were certain that all projectiles will strike normal to the surface. Unless they do so they will not perforate the armor mentioned by him at the ranges assumed. As a matter of fact, only a very small percentage of the shots fired will strike at all (two per cent at Santiago), and probably less than ten per cent of these will be normal hits.—Ed.]

Railroad Device for Indicating Speed.

One of the French railroads uses a novel form of speed indicator for its locomotives in cases where on account of repairs, defective structure or lack of attendance the speed is to be kept within a certain limit. It not only shows the speed, but when this rises above the required point it acts automatically to throw on the air-brakes. One of the locomotive axles drives a small centrifugal pump which sends water from the tender into a small cylinder. The piston of this cylinder is raised by the water against the compression of a spring, and moves up or down according to the speed of the pump or of the locomotive. The piston is connected with a registering apparatus which thus traces a speed curve. When the speed rises above the limit the piston acts upon a device which is connected with the air-brake pipes, and a certain quantity of air is allowed to escape, thus throwing on the brakes.

M. Santos-Dumont made two excursions on the Mediterranean in his dirigible balloon, January 28, at 10 o'clock and 2 o'clock. He was followed on the first excursion by the sloop "Monte Carlo," and in the afternoon by a steam launch from the yacht "Varuna," owned by Mr. Higgins. In the morning M. Santos-Dumont made the circuit of the bay several times, and in the afternoon he executed a number of interesting evolutions. The trials are most important, and the success achieved is even more important than his winning the Deutsch prize. At one time he was so far over the open sea that it was thought that he intended to make the trip to Corsica. His airship will be fitted for long voyages later. The Principality of Monaco is having a wooden jetty constructed in the bay, so that the floating guide-rope can be grasped at the moment of the return of the airship.

Automobile News.

There will be an exhibition of automobiles at Copenhagen from April 11 to 27, 1902, under the auspices of the Danish Automobile Club and Society for the Promotion of Industrial Arts. It will be held in the building of the last-mentioned society. The exhibition is designed principally to show automobiles. Some space will be given to motor cycles and articles relating to the driving of automobiles. The exhibition is intended to attract visitors from all the Scandinavian countries.

It is generally believed that petrol is liable to explode if kept in a hot place. But this is an illusion. Petrol flashes at the ordinary temperature of the atmosphere, or even at a low temperature, but this does not mean that under any circumstances whatever petrol is capable of flashing spontaneously without the presence of a flame. What is known technically as the flash point of a petroleum product is that temperature at which, when gradually heated in an inclosed cup, it will give off such an amount of inflammable vapor as will ignite when brought into contact with a flame. If a flame is not present petrol may be safely heated to any temperature, and yet will not ignite.

M. Deutsch, who offered the famous Deutsch prize won by M. Santos-Dumont, has made a laudable although unsuccessful attempt to do away with the cruel butchery in the bull ring caused by the use of a motor-car, in which the picador is seated, driven by M. Deutsch's chauffeur. The motor-car had its wheels armored and was driven into the ring amid great applause from the public. The bull was afraid of the car and allowed himself to be chased around the ring, his sole desire being to get out of the way of the unnatural monster. Only once, and then more by accident than by purpose, the bull turned on it, but immediately after receiving a prick from the picador he continued his ignominious flight.

Alcohol motors are now coming into use for heavy hauling wagons and tractors. One of the newest machines of this type has been built by the Société d'Automobile at Nancy. It made its trial trip lately on the roads between the different villages, especially for the transport of grain and flour to and from the mills of the district, and in one case it mounted the heavy grades of the village of Ludres with a load of 8,360 pounds of flour, and on another trip took a load of 8,140 pounds of grain. An average speed of 5½ to 6 miles per hour has been reached over the routes in the neighborhood of Nancy, which are quite steep in places. This is another case where alcohol motors have been used with success for the heavy automobiles.

An unusually fine display of automobiles has been seen at the last Automobile and Cycle Show held at Paris during the latter half of December. It is undoubtedly the handsomest display of machines that has been made so far. Most of the automobiles were of the gasoline type, and while there were few striking novelties a great number of carefully designed machines and up-to-date racers could be seen. The attendance was unusually large and shows the increasing interest which the public is taking in the question of automobiles. King Leopold III. of Belgium made a trip to Paris for the occasion and visited the Show often. The immense floor space of the Grand Palais was entirely covered with the stands, and in the basement was a special exhibition of automobiles and fixed motors driven by alcohol. Another feature was the aeronautic section, where the history of dirigible balloons as well as the latest forms of airships could be studied. A further account of the Show and some of the leading types of machines will be given later in the SUPPLEMENT.

The Fire Department of Hanover has lately been provided with a fine automobile equipment, including a fire-pump worked by a gasoline motor, a hook and ladder set and a steam fire-pump. In the first two of these the automobile is of the electric type with batteries, and in the last a steam automobile is used. The electric automobile and pump is designed to carry 6 or 8 men. Two motors drive the rear wheels by direct gearing, the use of two motors giving an advantage in case of a breakdown. The speed of this automobile is about 10 miles an hour, and it will cover 15 miles on a single charge. The batteries, disposed under the seat, comprise 42 cells in three wood boxes. The total expense for this form of automobile fire-pump is estimated at $250 annually. The hook and ladder has the same type of electric automobile. As to the steam pump, it will deliver 250 gallons of water per minute. The pump is of the two-cylinder type and is placed just back of the driver's seat. Between the pump and boiler, and mounted on the rear axle, is a small steam engine which drives the vehicle, with transmission by chain gearing. The boiler is heated by a gas-burner. The pump carries 5 men, sitting and standing, and makes about 12 miles an hour.

Engineering Notes.

A diamond drill boring 4,800 feet exists in Johannesburg, South Africa.

Residents on Park Avenue, New York, will be pleased to learn that such good headway has been made with the excavation of the tunnel for the Rapid Transit Subway between 34th and 42nd Streets, that it is expected that the headings will be driven through in about one month's time. This will mean the practical completion of one of the most important sections of the rock excavation.

The Trinity House Brethren have decided to erect a new lighthouse at Dungeness, a prominent point of the southern coast projecting into the English Channel. At this point the sea deposits huge quantities of shingle during the course of the year, with the result that the present lighthouse is now so far inland as to be practically valueless. The new lighthouse will be the third that has had to be constructed at this point. The first was erected in the reign of James I. by a goldsmith named Allen. Some twenty years ago it had retreated so far in shore that it was pulled down, and a new one was built by Wyatt at the expense of the Earl of Leicester on the model of the famous Eddystone. In the last sixty years the second lighthouse has receded about half a mile from the coast, and although its fixed light is visible for fifteen miles it is becoming a danger to shipping. The cost of the new lighthouse will be $30,000.

Steady progress is being maintained in the development of the gold mining industry of Rhodesia. The yearly output, according to the latest report of the British South Africa Company, now approximates the value of $3,750,000. The output for November was 16,308 ounces. The mining industry of Rhodesia is ripe for immediate expansion, and now that the railways of the Cape Colony are practically freed from interruption it has been possible to arrange for the immediate delivery in Rhodesia of the mining machinery and stores which have been accumulating at the ports. North of the Zambesi great progress has been made during the past two years. It is hoped shortly to throw the country open to prospectors, when, in view of its vast extent, and of the fact that deposits of gold, copper, and coal have already been met with, it is anticipated that the development of the country will proceed rapidly. The condition of the natives has also been greatly improved, and now a native can earn from $100 to $200 a year in the mines, in addition to his food.

The Birmingham gun trade is suffering severely from Belgian competition. Belgian-made guns, inferior in quality, are placed upon the English market stamped with an English name, so that they are often mistaken for English goods. Under the existing law reasonable protection is not afforded either to the British maker, the dealer, or the public. The continental makers are making strenuous efforts to secure the home trade in the United Kingdom, as well as the colonial and foreign trade; and, aware that English guns command a higher price, they copy the English styles. The number of proof-houses in Great Britain is increasing, and therefore the variety of proof-marks is increasing, so that the possibility of distinguishing the foreign from the home-made article is very difficult. Belgian makers resort to the practice of having their guns proved in London in order to get an English name on them. An attempt to remedy this grievance was made by the promotion of a bill by the proof-house authorities, by which guns were to be plainly stamped with the name of the country in which they had been manufactured, but the bill for some reason was abandoned.

In the British government Board of Trade Journal appears a report upon the twenty locomotives that were supplied by this country for use upon the railways of Burma, India. According to the locomotive superintendent, taken on the whole, the engines may be described as good, but at the same time he complains about the boilers, which contain several minor defects. At first the boilers did not steam freely and the coal consumption was extravagant. The company which built them, it is stated, in endeavoring to adopt certain British designs for details went somewhat astray. Among other things, the fact was apparently overlooked that in reducing the size of the engine the size of the engineman and the fireman remained the same as on the standard gage. Some strong criticisms are made concerning certain details of the workmanship. The accuracy with which interchangeable parts have been made is nothing like so exact as those of British manufacture. The local engineers were all very much astonished at this, as for years it has been maintained that in duplicate work we are far ahead of any other country. It is also stated that while material used in the construction of the engines is of a very high quality, yet in certain parts the makers have used material which can only be described as distinctly bad.

Electrical Notes.

Push buttons and annunciators have given place to the time-honored practice of clapping hands to summon a page in the House of Representatives.

At the last meeting of the Manchester Association of Engineers it was pointed out that the size of electrical plants is steadily increasing, and where only a few years ago 500 horse power plants were considered large, more than double this amount is now common. Nearly twenty years ago the Messrs. Ferranti urged the employment of 10,000 horse power installations, but capitalists could not be found to take them up. Plants aggregating much higher powers than the last are now in use (but not as units) in electrical railways.

A wireless telegraphic installation is being made on the Zugspitz, the highest summit in Germany, and the postal station at Ebisee at its base. The altitude of the observatory is nearly 2,290 yards above sea level. The station will be very important, as the meteorologist who occupies it is completely cut off during the winter months, and telephonic communication cannot be depended upon, owing to the liability of the cable being frayed by coming in contact with the sharp edges of the rocks. The Slaby-Arco system of wireless telegraphy will be used.

The Manhattan Elevated Railroad Company has begun to build a much-needed station at One Hundred and Tenth Street, which will be a model station. It would be impossible for the trains drawn by locomotives to stop on the curve, but there will be no difficulty when the road is converted to the electrical system. The elevated structure is at its highest point at this curve. Eight passenger elevators will be required to handle the traffic, though only four will be installed at first. The station will be of red brick and granite, and the roof will be of Roman tiles. The platform will be long enough to accommodate a six-car train.

The French government is seeking to devise a method of economizing the cost of its system of lighthouse lighting, since it is considered that this department is too expensive. In 1873 the best French lighthouses were illuminated by mineral oil, and the most powerful light equaled only 54,000 candles. In 1883 the electric light was introduced, by which means the illuminating power was greatly increased. In the case of Calais lighthouse the illumination was increased to 820,000 candles. At the present day, owing to the rapid progress maintained in connection with lighthouse illumination, a light equal to nearly 3,000,000 candles is produced, and which is capable of piercing fog.

The new underground electric railway of Paris has proved such a great success that extensions of the system are contemplated. A new line is to be opened at the beginning of 1902 from the Porte Dauphine to the Place de la Nation, traversing the outer boulevards. Another important extension is to start from the Palais Royal to the Place du Danube, following the line of the Avenue de l'Opera, the Rue Lafayette and other important thoroughfares, a total of about four miles and a half, with fourteen stations. The present line from the Porte Maillot to the Porte de Vincennes—both its extremities touch the Ceinture Railways—is merely the trunk of a system that will eventually push its branches into every part of the city. The Metropolitan will then offer to its passengers more accommodation than all the other public means of transportation put together, even including all the boats on the Seine. Every day over this short railroad, which is eight and three-quarter miles long, 140,000 passengers are carried. The company has received sanction from the Prefect of Police to run more trains to meet the increasing traffic.

An interesting lecture upon the various uses of electricity upon railroads was delivered by W. Langdon, the well-known electric expert of London, before the British Institute of Civil Engineers. Upon the various railroad systems of Great Britain there are at present in use 7,182 arc lamps and 85,683 incandescent lamps. Electric energy applied to power purposes aggregates 10,527 horse power. The total mileage of telegraph wire employed for railway purposes approximates 113,000 miles, excluding wires maintained for the Post Office, which represent another 86,000 miles. The number of telegraph instruments is 158,286. In telegraphy there has been a steady, continuous growth. As traffic and competition develop, so increase the demands on the telegraph service. No form of instrument has, however, proved of greater service in working the trains than the telephone. It has, in fact, become indispensable on all the trunk roads. In the interlocking of the electric block signaling instruments with the mechanical signals comparatively little progress has been made. The London and South-Western and the South-Eastern, and Chatham and Dover railroads have shown the greatest advance in this respect. Electric-lighted railway carriages are rapidly coming into vogue. Some 3,000 vehicles, chiefly fitted with Stone's system, are now running.

EXPLOSION OF DYNAMITE AT THE RAPID TRANSIT SUBWAY.

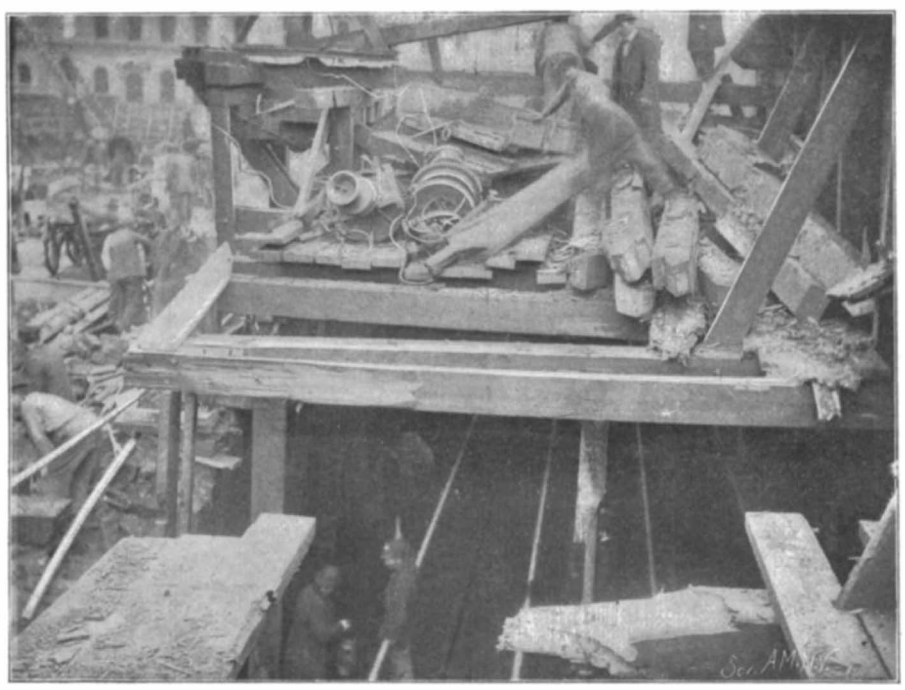
We present illustrations showing the destructive effects of the recent explosion of dynamite, which took place in New York city at the corner of Park Avenue and Forty-first Street, in the immediate vicinity of the Grand Central Station. It was due to the accidental detonation of some boxes of dynamite, which represented what was left of the daily delivery which is made at this point for the service of the particular section of the Rapid Transit excavation on which it occurred.

As we have frequently explained in previous articles on the New York Rapid Transit Subway, the tunnel is carried for a great part of its distance through solid rock, and where this occurs it is, of course, necessary to make use of high explosives in blasting out the rock. There are some sections of the Subway where the location of the line is continuously through solid rock. One of these is at Washington Heights, where the road passes into tunnel for several miles at a level that is in some places as low as 125 feet below the street surface. Another important rock-tunnel section is that which extends from Thirty-fourth Street to Forty-second Street. Here the four-track tunnel divides into two separate two-track tunnels, which are being driven below the existing tunnel, through which the tracks of the Fourth Avenue underground trolley road are carried. The two Subway tunnels do not lie immediately below the old tunnel, but on either side of it; and at either end of them vertical shafts have been driven, through which the excavated material of the tunnel is brought to the surface. Near one of these shafts, at the northern end of the westerly tunnel, at the intersection of Forty-first Street and Park Avenue, was a small shanty in which was stored the dynamite that was used in each day's blasting. The shanty stood at the surface of the street and not far from the railing which guards the street from the open cut by which the street railway tracks emerge from the mouth of the old tunnel as they approach Forty-second Street station. From the shanty to the front wall of the Murray Hill Hotel was a distance of about 25 feet.

According to the man who had charge of the maga-

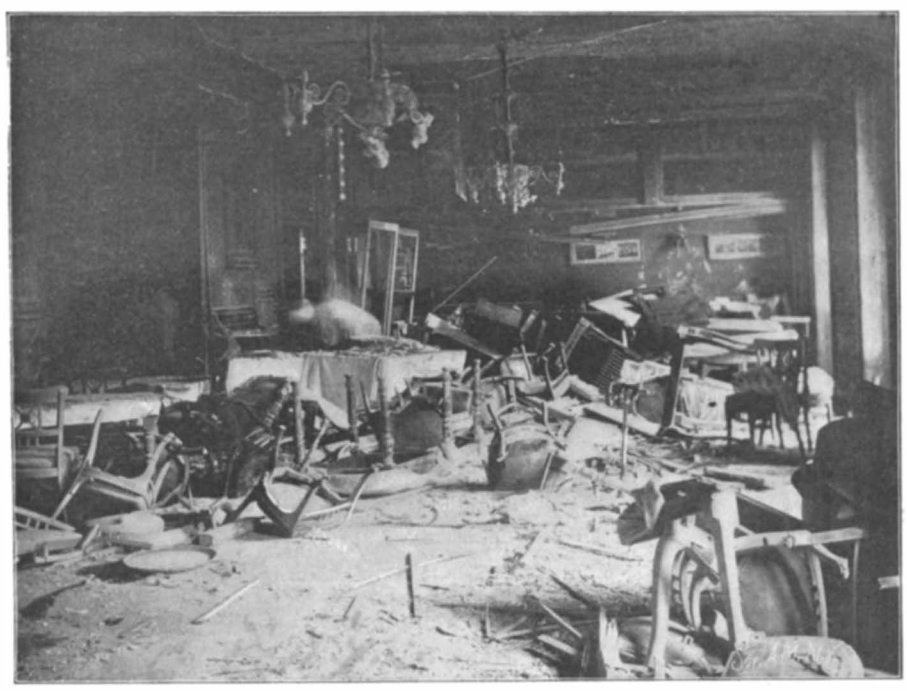
Looking South on Park Avenue. Cross Indicates Location of Dynamite.

Exact Locality of Explosion Showing Openings into the Subway and Park Avenue Tunnel.



View from Wrecked Platform of Hoisting Engine, Above Park Avenue Tunnel.

Looking South Toward Park Avenue with Subway Excavation at the Right of Tunnel.



View Inside Murray Hill Hotel Cafe Immediately After Explosion.

Northeast Corner of Murray Hill Hotel, Which Felt Full Blast of Explosion.

DYNAMITE EXPLOSION ON RAPID TRANSIT SUBWAY.

zine, there was several hundred pounds of dynamite in the shanty at the time of the explosion, or twelve boxes of dynamite, each box holding about seventy-five sticks. The boxes were on a shelf which stood about four feet above the floor of the shanty, while underneath the shelf there was scattered a lot of paper wrappings from the cartridges. The shanty appears to have been lighted by a candle, which was stuck between nails driven into the wall. The man in charge of the shanty supposes that the setting off of a blast must have shaken the candle down onto the floor, where it set fire to the paper. Whether this was so or not, he states that he had been gone but a few minutes from the shanty when he heard a cry of fire, and running to the door saw the paper cartridge wrappings on fire and the shelf burning. Although a bucket of water was thrown upon it, it failed to put out the fire. The man had not run far from the place before the detonation occurred. His theory is that the heat of the fire had warmed the dynamite, and that the burning of the shelf caused the whole mass to fall to the floor, the jar and heat together causing it to detonate. On the other hand, it is stated by the President of the Rapid Transit Commission that there were thirty pounds of combustible in the magazine on the night before the explosion, that 440 pounds were delivered next morning, and that four-fifths of this amount had been used, leaving only about 100 pounds on hand at the time of the explosion.

Although the results were disastrous, they were not nearly as fatal as one might have expected from the ordinarily crowded condition of the streets at this hour. In all five persons lost their lives, three of them in the Murray Hill Hotel, and two or three hundred persons, the exact number of whom will never be known, were more or less injured. No great damage was done to the Rapid Transit Subway, the loss being confined to the destruction of a derrick and hoisting engine and some platforms and timbering of the tunnel shaft. The most serious destruction was that wrought on the adjoining buildings, and particularly the Murray Hill Hotel. On this building the force of the blast was sufficient to shatter not only every window, but practically every window-frame from street line to cornice. A mass of mud, earth, and splintered timbers was hurled into the nearest rooms, and the glass wreckage and blast of the explosion overturned furniture, wrecked the chandeliers and brought down large portions of the ceiling. The condition of the interior of the hotel may be judged from the photographs which are herewith presented. One of the fatalities occurred in a bedroom immediately opposite the scene of the explosion, the occupant being buried beneath a mass of rubbish, while another person was killed at the cigar stand. On the opposite side of Park Avenue the windows of the Manhattan Eye and Ear Infirmary were completely shattered, the same effects being produced on the Grand Union Hotel.

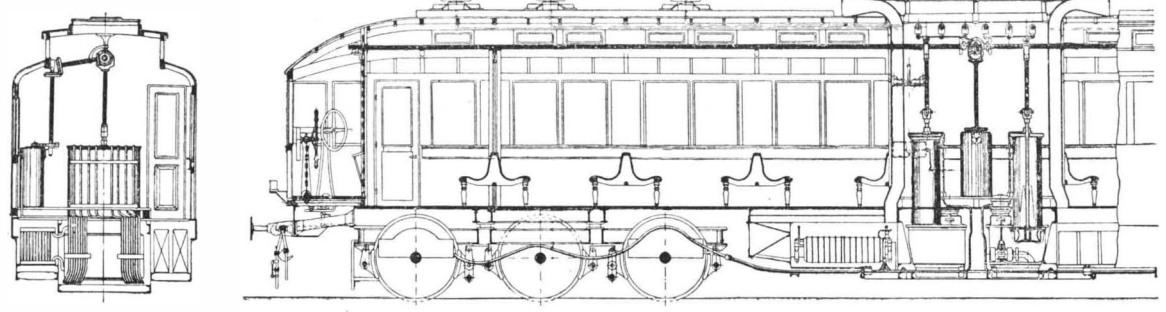
A curious effect, noticed immediately after the explosion, was a heavy piece of planking which had been driven through the cornice of the tower of the Murray Hill Hotel and hung in this position over 100 feet above the sidewalk. Another incident that attracted much attention was the instantaneous wreck of the two large clocks in the towers which flank the southerly façade of the Grand Central Depot. The clock faces were blown from their setting back into the clockroom. It is a matter for congratulation that, although the explosion occurred within a few feet of the tracks of the Metropolitan Street Railway, no lives were lost nor passengers seriously injured. It so happened that, although this is one of the most busy points on the system, there was no car in the immediate vicinity at the moment of the disaster.

HIGH-SPEED GERMAN RAILWAY AT ZOSSEN.

BY FRANK C. PERKINS.

The high-speed polyphase railway experiment is creating great interest in Germany as well as in this country. A speed exceeding 100 miles per hour has been attained of late, and it is claimed much higher speeds are possible.

The line installation, as well as the electrical equipment of one of the cars, was furnished by Siemens & Halske. This line is operated between Marienfelde and Zossen. The current is supplied from the power station of the Allgemeine Elektricitäts Gesellschaft at Oberschönweide. The accompanying illustrations and description have reference to the car equipment of the Siemens & Halske Company, of Berlin. The cars were supplied by Van der Zypen & Charlier, of Cologne, Germany. The road is about 14 miles in length, with grades up to 3 per cent. The current supplied has a frequency of 45 to 50 periods per second and a potential of 10,000 volts. The car as seen in operation may be noted in the accompanying photographic and diagrammatic views showing detail of construction and the arrangement of passenger and apparatus rooms. Cross seats are provided for 60 passengers in a center room and two end rooms, the former being nearly 8 meters and the latter about 4 meters long. The total length of the car is 22 meters, with platform at each end nearly 2 meters in length, from which the operator controls the car. Automatic Westinghouse brakes are used, two 10-inch cylinders being used for each truck, and the brake rods being so arranged that they may be applied by hand from either platform of the car.



LONGITUDINAL AND CROSS-SECTIONAL VIEWS OF CAR BUILT BY ALLGEMEINE ELEKTRICITAETSGESELLSCHAFT.

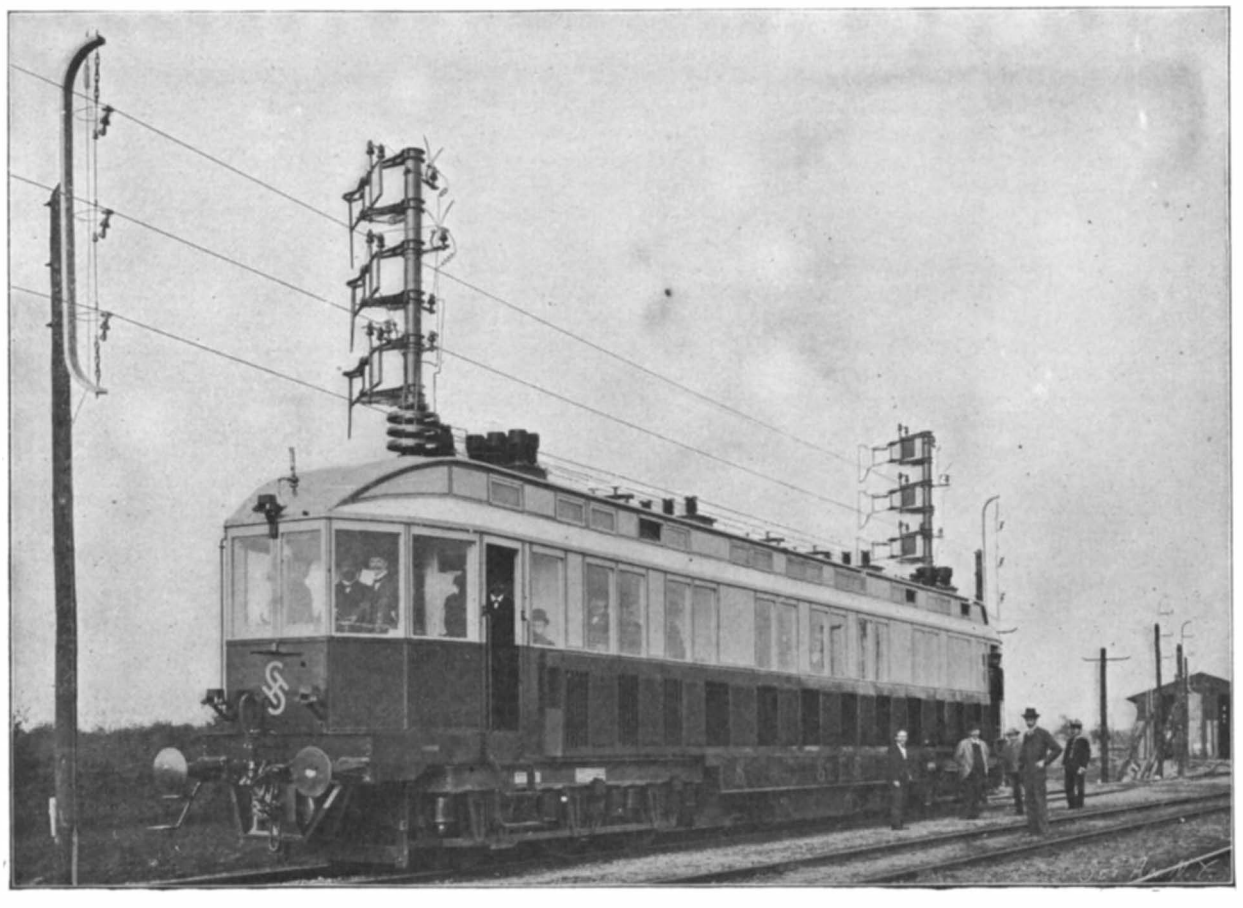
Compressed air is used not only for the operation of the brakes, but also to control the electrical apparatus from either platform of the car. Two sets of electrical apparatus are used, each consisting of two rheostat controllers, two motors, two motor switches, a large step-down transformer, together with an air pump with its own transformer and the necessary current collectors in three parts for conveying the current from the overhead wires to the transformers and motors. Two motors are supplied to each truck directly mounted on the axles, each of which has wheels 1,250 millimeters in diameter (about 4 feet). Each motor has a normal capacity of 250 horse power to 500 horse power. The four motors, when heavily loaded, have a capacity of 3,000 horse power, or 750 horse power each. The primary pressure is varied from 1,850 volts to 1,150 volts from starting to full speed, the currrent of primary being respectively 280 amperes and 120 amperes. The voltages of the secondaries of motor are 1,000 volts and 540 volts, while the current is 550 and 210 amperes.

The metallic resistances are placed behind the open shutters seen on the side of the car in the accompanying illustration. The cold air rushing through the openings keeps the temperature of these resistance coils down, as a large amount of heat is generated in regulating the speed of the motors by cutting these resistance coils in and out of the secondary circuit of the motors. Cold air is also supplied by pipes extending above the roof of the car, as shown in the diagram.

The high tension transformers operate at from 30 to 150 amperes, the potential of the primary being 10,000 volts, while the secondary voltage is varied according to whether the secondary winding has delta or star connections. The high tension winding is always connected as a star winding and carried through safety fuses to the distributing wires and thence to collector trolley.

The accompanying views show the car and high tension line to good advantage.

The line is divided into parts each 1 kilometer in length, a feeder connecting the center of each section. The poles are nearly 8 feet from the track, the three conductors being mounted vertically one above the other, the lowest about 20 feet from the ground. The poles are somewhat more than 100 feet apart, are of wood construction and have mounted upon them bow-shaped arms, the conductors not being rigidly fastened, but supported upon insulators of hard rubber mounted upon a vertical chain and wire system, as seen in the figure. The conductors are hard-drawn copper of 100 square millimeters in cross-section and have a conductivity of 97 per cent pure copper.



SIEMENS-HALSKE HIGH-SPEED POLYPHASE CAR.

Each trolley wire at its supporting insulator is connected to a loop of copper wire about one-third of an inch in diameter which is designed to become grounded in case the trolley wire breaks; by being pulled into contact with a vertically-suspended wire of the same cross-section, having a coil spring near its upper support, its lower end being directly connected to the track. Copper rail-bonds are used, and ground plates are placed at each section of the track. The four feeders on the high tension line consist of three high voltage conductors and a neutral wire mounted on porcelain insulators. Part of the conductors consist of insulated cables and part of bare wires, the latter having 50 square millimeters cross-section and the former having 70 square millimeters cross-section.

The current is collected from the trolley wires at the side of the track by three bow-shaped collectors specially designed for this installation. These are mounted on a mast consisting of two telescoped tubes about 8 inches in diameter. A mast is mounted at

each end of the car, passing down through the roof, and may be revolved by the motorman by means of a handle through a set of gears. The collectors are of steel tubing and may be easily detached.

The trolley wire insulators were tested under rainy conditions to 20,000 volts and the electrical equipment of the car, including all circuits in apparatus, were tested to 15,000 volts, while the large and small transformers were tested for an hour under a potential of 20,000 volts.

The high tension switches have a double break on the three branches and are of the tube type. The switches are placed in sheet-iron boxes next to the small transformers. To the cover of each box the six insulators are fastened. The switch is closed by the raising of the plate operated by the air-cylinder piston. The compressed air which is used for the operation of the electric switches as well as for the air brakes is obtained from two electrically driven air pumps placed under the car.

The duplex pump operates at 190 revolutions per minute, the two cylinders compressing 400 liters of air to a pressure of 8 atmospheres. Each motor is operated from a small step-down transformer supplying 110-volt current to the motor terminals. Each platform is supplied with the necessary cocks for controlling the air in the rubber tubes and iron pipes beneath the floor of the car, connected with the starting cylinder. Within sight of the motorman are the various air-pressure gages, ammeters and voltmeters.

The large transformers noted in the accompanying diagrams are placed beneath the car, the cores being provided with air pipes for cooling. The windings are heavily insulated with mica, the leads passing through porcelain insulators at the ends. heavy steel plates holding the coils together by several heavy bolts. The leads from the transformers are connected to four high-tension fuses of the mica tube type. The secondary current from the step-down transformers is supplied to the motors after passing three sets of safety fuses and switches. The motor switches have double breaks of 140 millimeters in each phase, six tubes with contacts being placed in a circle, the switch being operated by means of compressed air by an air cylinder in the center of the circle.

Two transformer switches are required, one connecting the secondary for delta and the other for the star winding. In starting the car each of the four motors supplies 750 horse power, or about three times the full speed current (250 horse power), about 20 horse power being cut out at each step. There are 29 steps, 25 of which are used for gradually increasing the speed and 4 for cutting in the motor. The controller cuts in the four motors one at a time by means of two air cylinders, working in opposite directions. The air cylinders are of different diameters and so arranged that the controller may be stopped at any particular contact.

There are three large and three small resistance boxes—one for each phase. The larger boxes each have 25 coils and the small ones 4 coils. The air is supplied from the outside of the car through the numerous openings, keeping the resistances at a proper temperature.

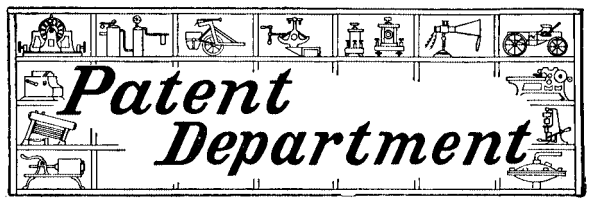
The motor has six poles and is directly connected to the car axle, which has a speed of 900 revolutions per minute, the diameter of the car wheels being a trifle over 4 feet. The rotor of the motor is mounted directly on the axle, and is about 2 feet 6 inches in diameter. The rotor carries the primary pressure of from 1,150 to 1,850 volts, the current being conducted through three collector rings, upon each of which eight carbon brushes press, giving the necessary contact. The slots of the rotor are well insulated with mica, and wooden wedges are used to hold the bar winding in place together with the usual wire bands.

The stator winding is of the ordinary alternating kind, 72 slots being used in the secondary and 96 slots being used in the primary, the motor having a 6-pole winding. The total weight of the car fully equipped is 88 tons, being very close to that previously calculated.

The Current Supplement.

The current SUPPLEMENT, No. 1,362, is begun by an article on Mexico, accompanied by a number of illustrations. "The Bursting of Small Cast-Iron Flywheels" describes some very ingenious experiments which were tried. "The Venom of Serpents and Anti-Venomous Serum" is accompanied by a number of illustrations. "Recent Science" is by Prince Kropotkin.

On January 1 the new Japanese patent law went into effect. Under this an inventor who has applied for a patent in a foreign country will obtain priority as from the same date in the United Kingdom, if, within twelve months, he files an application there. He, however, loses the advantage that may be gained by first applying for provisional protection only, as he must at once file his complete specification.



Profit in Patented Inventions.

A writer in The New York Sun considers a good patent as valuable as a gold mine in its way. Patents and gold mines resemble each other very much in one respect; there are no infallible signs by which one may recognize the bonanzas. No matter what the prospectus may say, the mine must be worked before its value may be known. No matter what the theories of the inventor may be, the world's market, and not himself, must determine the value of his invention.

Some very large fortunes have been made out of apparently trivial inventions. There is much luck in the first place. But skill in handling the patent counts for even more than luck. The little rubber stopper with the wire attached to it, which is used now on every beer bottle, is a good example of fine business management in the handling of an apparently trifling invention.

Often the inventor fails to realize the value of his device. Everyone is familiar with the hook eyelet now commonly used on boots and shoes. The man who invented it could dispose of it only by selling the complete title to his patent to a shoe company. Even the shoe company did not fully appreciate the value of the invention which they had acquired; for the hook and eyelet was regarded as an eccentricity and would require expensive machinery in its manufacture. It is said that the inventor realized $600 for his hook and eyelet; the profits to the manufacturers were some hundreds of thousands per year.

Some inventions, says the writer, drag along for years without getting to a paying stage, and then suddenly make fortunes for their owners when the patent is almost run out. The typewriter is an example of this thing. The men who believed in it had many reasons for giving up all hope of its ultimate success. The man who had the general agency for the whole South in 1877 sold only four machines in a year, three of them in one town, Huntsville, Ala. It was not until the most valuable part of the patents had expired that any one made any money on the typewriter. Bell offered to sell a half interest in his telephone to his next-door neighbor for $1,000, and the neighbor laughed at the absurdity of paying such a price for an interest in a freak scientific toy.

Speaking of Bell's telephone, it is not generally known that he came very near losing all his English patent rights, and would have done so, but for a most remarkable piece of luck. At the time of the telephone's invention Lord Kelvin was in this country, and he took back with him to Scotland one of the crude instruments which Bell had made, intending to exhibit it to his college classes as an American curiosity. At that time the transmitter had a spiral spring on the upper side, and while the model was knocking about among the scientist's baggage in its journey across the ocean this spring somehow got bent upward. When Lord Kelvin came to give the promised exhibition the thing would not work, because the spring was bent up too much. It is almost impossible to believe, but it is nevertheless a fact, that it never occurred to the giant intellect of this great scientist to press that spring down again, and he had to apologize to his audience for the failure of the much advertised experiment. A publication before application for a patent is a bar in England, and when the great trial to settle the validity of the Bell patents came up over there, it was sought to prove this previous publication, and this lecture was a case in point, but it was conclusively proved that there had been no publication in this lecture, because the model would not work. Had Lord Kelvin pressed down that little spring and shown those Scotch laddies how the telephone worked it would have cost the Bell company many millions of dollars and made telephones very cheap in England.

Most successful inventors are men who have been brought up in connection with the business to which their inventions are to be applied, or have at least made themselves familiar with the laws governing the processes which they seek to improve. There are cases in which inventors have discovered new laws or new applications of old ones, especially in chemical processes. The Bessemer converter is a familiar example. The cyanide process of washing gold and the manufacture of acetylene gas are others. Some inventors have had courage enough to dispute the established facts of science, as in the case of some recent experiments in fog signaling, in which the inventor used the principle denied by such eminent authorities as Tyndall and Prof. Henry.

It is well known that there is very little money in surface washing or placer mining for gold, and that all the big profits are made out of long and patient development of deep mines. The same is true of patents. There is very little profit in inventions which can be realized upon almost immediately. They are mere surface washings. All the big things have taken time and patience to bring to perfection, and any inventor who finds himself making quick profits may be sure they will be short-lived, although he may have a good thing while it lasts, like the pigs-in-clover puzzle. Confidence, tenacity of purpose, and capital are the requisites for building up big fortunes on the foundation of a patent; the thing itself must have intrinsic merit to begin with or it must fail before long.

The simplest inventions are the best money-makers, because to perfect complicated machines costs time and money. A great many have ended with the original conception, the inventor having no ability to handle detail so as to carry out the original idea in a practical way. The Bessemer process of converting steel is extremely simple, blowing hot air through the molten metal. Just sit down and get out the drawings for a machine which will carry out this idea, especially the arrangements for controlling the supply of air that is admitted to the converter, and see how soon you will find that the first idea is a small part of the invention as a whole. The use of compressed air as a motive power was understood and appreciated thirty years ago, but no one could invent a governor which would control it, although hundreds of patents were taken out which professed to do so. The power of the steam from a kettle was evident to Watt long before he could devise a means of utilizing it. The combination of the piston and the slide valve, which looks so simple to us now, was not worked out in a day.

It is a common practice to speak contemptuously of inventors on account of their exaggerated notions of the value of their ideas. When the invention is obviously a delusion this is quite natural, but it must not be forgotten that without this infatuation for the creatures of their brains inventors would be much more easily discouraged than they are, and many of the most valuable inventions might be lost. The tenacity with which some of them cling to their ideas until they finally force their adoption upon the world almost amounts to inspiration. It seems born in some men to fight harder for the children of their brains than for their families, and it seems a pity that their reward is not often greater than it is.

Novel Uses of Electricity.

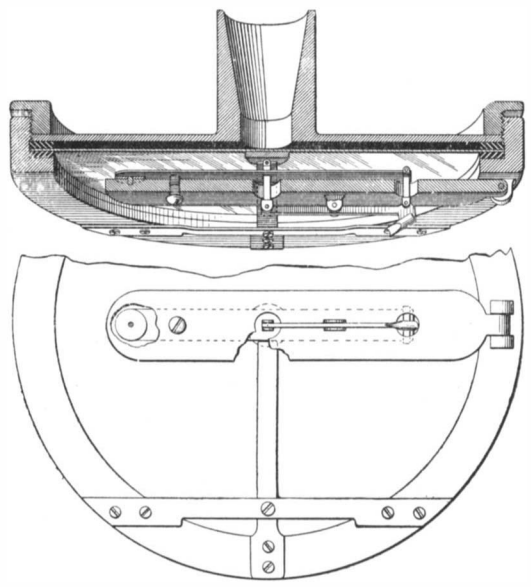
An electrical steam boiler is the subject of an invention patented by Charles E. Griffing, Hamilton, Ohio. The boiler shell is wound with copper wire which is suitably covered with an insulator. The water-heads are secured at each end of the boiler and are connected by pipes running the full length of the boiler and provided with a series of minute perforations directed to the interior face of the boiler-shell. Additional water-heads at each end of the boiler are secured immediately within the previously mentioned water-heads, and are connected by perforated pipes. These additional water-heads are divided into three separate compartments. A series of alternately arranged heating pipes is introduced between the water-heads to connect the water-pipes or tubes. These heating pipes are provided with electrical conductors, suitably insulated from each other and from the pipe in which they are inserted. The conductors in the several heating pipes are connected in series and arranged to be disconnected separately for purposes of repair. The insulation employed, although a non-conductor of electricity, is an ample conductor of heat. The first-named water-heads are connected with the source of supply, whereby the desired amount of steam can be generated.

Mr. Elihu Thomson, who is well known for his numerous inventions, has devised an apparatus for uniting the edges of metal sheets, which apparatus is applicable to the joining of separate sheets or plates of metal, or to the joining of two opposite edges of a single strip or sheet formed or shaped so that its two edges will approximate. The invention is particularly useful for the protection of pipes by forming or rolling up a strip or skelp into a cylindrical form, and in making a joint between the longitudinal approximated edges. The invention is carried out by approximating the edges to be joined, preferably upturning them so that they are in contact or nearly in contact. A strip of metal or wire, which is adapted to be joined by welding to the pieces to be united, is laid along the line of the joint. An electric current is passed transversely through the wire or strip into the joint and through the edges against which the wire is laid, the volume being sufficient to bring the wire and edges to the welding temperature. Pressure is then applied to cause the edges of the wire or strip to weld or unite in order to form one piece, thus completing the joint. In forming a pipe, a strip or piece of sheet metal is rolled up into the form of a hollow cylinder with the edges meeting to produce a seam. Into this seam or joint is laid a wire or thin

strip of the same metal or other allied material, and under the pressure of current-conveying contact-rolls, the wire is flattened and pressed into this joint. The union takes place under pressure and electric heating. It is said that the parts are so homogeneously welded together that the pipe is practically one piece.

INTERESTING NEW INVENTIONS.

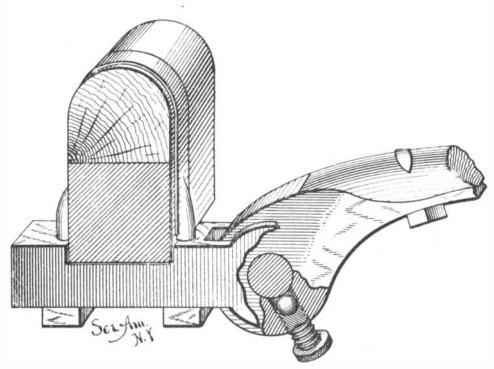
EDISON'S NEW PHONOGRAPH.—Phonograph diaphragms are usually placed under strain by the compensating weight employed to cause the stylus to press upon the wax and at the same time to accommodate any eccentricities in the blank. These strains destroy much of the sensitiveness of the diaphragm. Mr. Edison therefore employs a counteracting spring co-operating with



EDISON PHONOGRAPH-RECORDER.

the diaphragm. This spring counteracts the normal strains to which the diaphragm may be subjected, and which may be due either to the employment of the usual compensating weight or to the direct engagement of the recording device with the record. Our illustrations represent a partial sectional view through a phonograph recorder employing a compensating weight, and a bottom view of the improved recorder. The spring is connected at one end with the weight and at the other end by a link with the working end of the lever-carrying stylus.

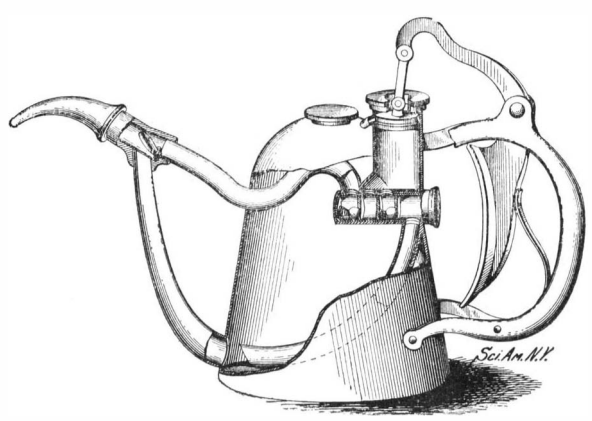
THILL-COUPLING.—A ball-bearing thill-coupling of an improved form has been patented by Seth Bartholomew, of Sturgis, Mich. The thill-iron has a threaded aperture in which a steel ball fits. A screw-threaded



BALL-BEARING THILL-IRON.

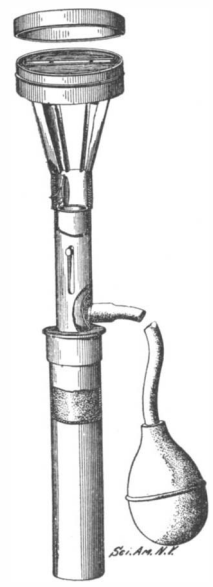
bolt has its inner end concave to fit the ball. By screwing up the bolt from time to time, the ball is pressed in, thus preventing rattling and providing a smooth, movable pressure conducive to the uniform wear of the parts in contact.

PUMP OIL-CAN.—A can from which oil can be either poured in the usual manner or driven out has been devised for the use of engineers. Time is saved and spilling and wasting of the oil is prevented. The can is provided with a pump, the piston-rod of which is pivotally connected with an operating-lever fulcrumed



COMBINED OIL-CAN AND PUMP.

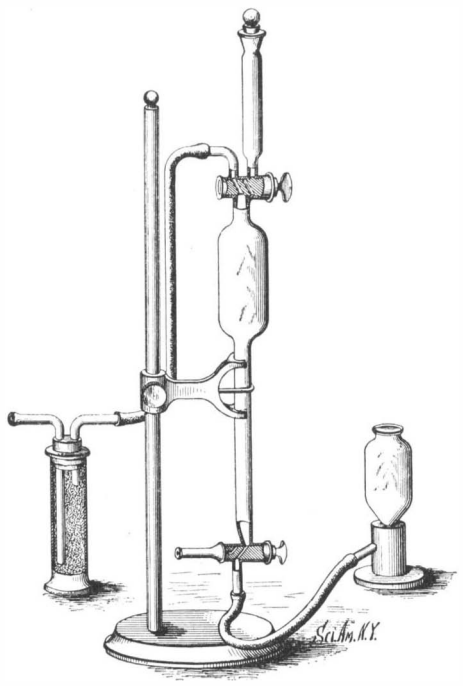
on the handle of the can. A stout spring serves to return the pump-piston automatically to its normal position after operation. The pump-cylinder is connected with a valve-casing comprising valve-chambers arranged to be closed by spring-pressed valves. A pipe leads into the oil from the one valve-chamber, and a second pipe leads to the spout. By actuating the operating-lever the pump-piston on the up-stroke will draw oil into the chamber, press back the first valve, and permit the oil to flow into the pump-cylinder. The next down-stroke of the piston will force the oil past the second valve and down through the spout. A spout-pipe of the usual pattern is also provided to permit the oil to be poured out of the can.



A NEW FLASH-LAMP.

FLASH LAMP.—In a flash-light of recent invention, the flash powder is held in a reservoir from which charges are successively drawn and blown into the lamp frame. The lamp is, furthermore, provided with separate burners that can be interchangeably connected with the reservoir to vary the width of the flame produced. The first of these ends is attained by means of a receiver into which the powder is introduced from the main reservoir by inverting the lamp. To prevent the powder from running out at the opposite end of the receiver a hinged cover is provided which can be operated by means of an arm. By employing an extension of flattened tubular form to be fitted over the outlet tube a longer flow of powder and corresponding increase in duration of the flame are obtained.

GAS-ANALYZING APPARATUS.—An exceedingly rapid, as well as a direct method of quantitatively analyzing gas is the invention of C. C. Tutweiler, of Philadelphia, Pa. His titration apparatus comprises a graduated burette



STREET GAS ANALYZER

provided with three-way valves located at the top and at the bottom. By means of the top valve the burette can be placed in communication with a tar arrester; by means of the bottom valve the burette can be placed in communication with a mercury-leveling bulb. A stoppered graduated vessel is arranged to drop iodine or other liquid into the burette. By properly manipulating the valves and the mercury bulb, it is possible to obtain in the burette a definite volume of gas measured at atmospheric pressure and under a negative pressure. Small quantities of a standard iodine solution are dropped into the burette in measured quantities. The quantities so introduced are proportional to the sulphureted hydrogen in the burette, or in other words, in a measured volume of gas which it contains.

How the Welsbach Light Was Discovered.

While engaged in the spectroscopic examination of the light emitted by incandescent erbia and other rare earths Auer von Welsbach found that a small fragment of the earths held on platinum wire did not give sufficiently bright spectra. In order to increase the available illuminating surface he adopted the plan of impregnating pieces of cotton fabric with the salts of the earth. When the cotton was subsequently burnt out the residual oxides were found to be sufficiently coherent for his purpose. Lanthanum oxide treated in this way glowed so brilliantly as to suggest the possibility of applying it to practical illuminating purposes. Thus the idea of the "incandescent mantle" originated. But a mantle of lanthanum oxide was found to disintegrate when exposed, owing to the absorption of moisture and carbon dioxide. This fact led to the use of other oxides, notably zirconia and thoria, in admixture with the lanthana for the purpose of imparting stability to the mantle. Auer thought that such oxides must be so intimately mixed as to form a "molecular mixture." Haitinger, who assisted Auer, then discovered the value of small proportions of ceria in improving the illuminating power of the mantles.

So far the development of the invention had been commercially unsuccessful; the fortunes of the companies concerned were at a very low ebb. Auer again turned his attention to the use of thoria, then a very rare and costly substance. After fifty or sixty hours the light, although originally improved, fell off until it was no better than that of mantles made without it. Then began investigation into the nature of thoria. Crystallization methods were devised whereby it could be prepared in a pure state quickly and in considerable quantities. Then the astonishing discovery was made that the purer these thoria were the lower was the illuminating power of the mantles, until finally a point was reached at which the mantles had very little illuminating power at all. A keen hunt for the light-exciting substance finally led to the discovery that ceria, which persistently clings to thoria and can be removed therefrom only with the greatest difficulty, was the true light agent. Cerium solution was now added gradually to a purified thorium solution, and at last the well-known thoria-ceria mixture, giving the brilliant results of the present day, was invented.

New Magnetic Ore-Separators.

The idea of separating iron ore from the crushed rock in which it is contained was first prominently brought to the public attention by Thomas A. Edison. Since his very elaborate experiments, other inventors have entered the field. A Philadelphia inventor, Marcus Ruthenburg, comes to the fore with a new magnetic separator for ore. In the machines hitherto constructed, much of the magnetic force is expended in bodily uplifting the particles of magnetizable material from the gangue and sustaining the weight of the particles during their progress through the machine without other support than the stress of the magnetic field. Mr. Ruthenburg has devised a magnetic separator wherein the magnetizable portion of the material treated is supported during the process of its extraction from the gangue by means independent of the magnetic field. As a result of this contrivance, an economy of magnetic force by no means inconsiderable is said to result.

Another Philadelphia inventor, Robert McKnight, has devised an improvement in magnetic separators in which the ore flows down an incline of considerable extent over a belt passing in front of a number of stationary magnets. It has been found that in such machines the particles of ore that cling to the belt and are carried upward by it, move through varying fields of force. If the belt be composed of a sheet of magnetic material, or if it contains large sections of the magnetic material, changes of polarity in this material will disturb the attraction of the magnetic particles to the belt and tend to dislodge them from it. Moreover, if the belt be metallic, the difficulty of moving it in front of the magnet is considerable. By causing the belt or apron on which the ore flows and on which the magnetic particles are collected to move together, Mr. Knight believes that he obviates these objections.

Phonographic Improvements.

Among the patents recently granted in the United States are two which relate to novel methods of producing and reproducing sound records, the inventors of which, Emile Berliner and Gianni Bettini, are both well known for their many experiments in the reproduction of sound.

Berliner's invention is concerned with a new method of producing gramophonic records. The invention consists in the method of forming a preliminary groove in a gramophone disk and then superposing the sound record upon this groove. It is claimed that any person can make a sound record by means of this grooved tablet without the use of other machinery than that which he is already supposed to possess. The ordinary gramophone is only a reproducing machine; but by means of this invention it can be converted into a recording machine.

Bettini's invention is concerned with a very ingenious method and apparatus for duplicating or multiplying master records. An ordinary microphone-transmitter provided with a stylus is designed to follow the sound-record line of the master-cylinder. This transmitter is in circuit with a source of electricity. The fluctuations of the current caused by the vibrations of the diaphragm of the transmitter are utilized to effect corresponding movements in the parts carrying the reproducing styli in contact with the cylinders upon which the record of a master-cylinder is to be duplicated. In other words, Bettini reproduces his master-record telephonically.

Brief Notes Concerning Patents.

A system of wireless telephony, invented by Nathan Stubblefield, of Murray, Ky., was given a public demonstration at that place on December 31 in the presence of a number of the learned men of that vicinity and prominent officials. The tests are reported to have been very successful. The instruments used are very similar to the ordinary telephone paraphernalia and the communication is carried on through the earth.

M. J. Dolphin, of New York city, the inventor of a number of devices for use in the Post Office Department, was in Washington recently arranging for the introduction of some new machine for canceling stamps on letters. He says the latest thing in this line is an electrically-driven and thoroughly automatic machine which handles between 40,000 and 50,000 letters an hour. The size and shape of the package are not considered at all, and one passes through the machine the same as another, which is a new feature in the operation of these machines. Another innovation is that the stamper is arranged to strike the stamp but once. In large letters heretofore there were sometimes several impressions on the envelope.

Frank Israel, of Wichita, Kan., is the inventor of a process of seed planting which he claims presents great advantages over existing methods. He has invented a machine which places seeds at regular intervals along a tape of paper. These tapes are supplied in any desired length, and by their use the seeds can be planted at the right distance so that the best results will be secured. He has also invented a machine resembling a hand drill for placing these tapes in the ground. This is an adjustable device by which the ribbon of seeds can be placed at any desired depth. The seeds and machines are about to be placed on the market.

The attention of J. Hampden Dougherty, of the Department of Gas, Electricity and Water of New York city, has been called, in a letter from Mayor Low, to a patent appliance for measuring the amount of water flowing from a hydrant. This is especially designed for the use of fire departments, and is said to be of great value to the engineers, but such gages have never been generally used in this country. This particular invention is the design of E. S. Prentice, of the London County Council, who is also a member of the Institute of Civil Engineers. The device has been in use in London for a number of years.

John E. Anger, the manager of the Electric Railway, Tramway and Carriage Works, Ltd., of Preston, Lancashire, England, was formerly a resident of Wilmington, Del., where he was employed by the Jackson & Sharpe Company. He has been in England for a number of years, and during that time he has invented several devices which are in general use on the street transportation lines of the larger cities abroad. His latest effort is a means of automatically taking up the slack which occurs in braking apparatus due to the wear on the brake shoes. This has been patented in this country as well as those of Europe. It has been in successful operation on one of the Liverpool lines for some time.

The Board of Public Improvements of the city of St. Louis recently undertook to put the stamp of their approval on some one design of street car fender to be adopted as the standard for use in that city. In a few days after the announcement the Board found itself overwhelmed with models and inventors. The deluge was so great that the Board was compelled to recall the feature of the invitation to competitors which provided that each design would be given a trial, and only those which were the most promising were put to the test. This greatly angered those who were slighted and the Board got itself heartily disliked by all the inventors of the city. The contest resolved itself down to ten designs, which are now being practically tried on the cars of the city, and the one which seems to answer the purpose best will be finally selected.

Experiments with the submerged bell as a means of signaling for marine purposes have been going on some time, and it is said that the idea has been greatly improved since the first tests several months ago. An 800-pound bell suspended from the barge "Sea Bell" was struck with a force only equal to a 1-foot fall of a 50-pound pile driver, and the vibrations made were clearly noticeable on board of the "Ivernia," which was in another part of the harbor about a mile away. The clearness of the signals was most startling, and a number of those present could hardly be convinced that the vibrations of a bell rung a mile away could pierce the thick skin of the steamer and make themselves manifest with such remarkable distinctness. The sounds were noticed by the men on other boats in the harbor who were unacquainted with the cause. This system is the joint invention of the deceased Elisha Gray and Arthur J. Mundy, of Boston, Mass. In the Scientific American of February 2, 1901, will be found a very complete illustrated article on the system written by Mr. Mundy himself.

Legal Notes.

Presumption and Evidence as to Inventorship.—The United States Circuit Court of Appeals for the Seventh Circuit has handed down a decision in the case of the Barr Car Company vs. Chicago and Northwestern Railway Company—a case which is rather remarkable for the curious circumstances out of which it arose. The suit was brought by the appellant as the assignee of Lester J. Barr for the alleged infringement by the appellee of letters patent for a "coal and iron car." It seems that the railway company had employed a certain George H. White in various capacities, and that in 1881 he conceived the idea of a single-hopper, double drop-bottom car designed to overcome grave objections in the cars then in use by the company. A verified application for a patent was filed February 12, 1883, but was abandoned by White because the claim finally allowed was so narrow that he deemed it useless to pay the final fee. While White was employed by the railway company Barr entered his office as a draftsman. Barr claimed that between 1880 and 1883 he conceived the idea of the car for which White filed an application; that he prepared both specifications and drawings, signed them, and verified them as a witness. Neither prior to their execution nor thereafter until he left service under White did he make any claim that he was the inventor of the car, although White had publicly declared himself as the inventor. Barr's application for a patent was filed January 6, 1886, and was finally allowed in a restricted form. Barr explained his silence by reason of certain unfortunate business ventures, which necessitated his coming to some arrangement with White contrary to the rules of the company, whereby he might pay off certain of his creditors. Because of this fact he claimed that he did not suggest to White at the time that he was the real inventor, fearing that White might cause his discharge. When White left the service of the Chicago and Northwestern Railway Company Barr accompanied him.

The Court admitted that a patent raises a *prima facie* presumption that the patentee is the first and original inventor; but the fact that Barr had prepared an application for the same invention for another person and signed it as a witness overcomes this presumption, and throws upon him the burden of proof that White was not the inventor. The fact that no claim was made by Barr until three years after he had drawn up the specification and made the drawings must tend to defeat his assertion; for such an action is not that of a reasonable man. In the absence of active compulsion by White, who was his superior, Barr's statement that he feared the loss of his position if he asserted his right to the invention in the face of the claims of his superior is not entitled to great weight. For the Court held it would be carrying the rule of compulsion or duress a great way and to a dangerous extent to hold that anyone occupying a subordinate position is not to be bound by his acts because of a fear of a possible loss of employment.

The Whitehead Torpedo Suit.—In the United States Circuit Court for the Eastern District of New York a suit was recently brought by the Howell Torpedo Company against the E. W. Bliss Company, American manufacturers of the Whitehead torpedo, for alleged infringement of Letters Patent No. 311,325, issued to Admiral John A. Howell, June 27, 1895, for "certain new and useful improvements in marine torpedoes." The question at issue was whether the Howell flywheel was an anticipation of the Obry gyroscope. It seemed undoubted to the Court that Admiral Howell was the first person to suggest and use a rapidly-revolving flywheel in a marine torpedo to preserve fixity of direction and to secure the torpedo against the influence of deviating forces. The gist of Howell's invention, so far as the correcting of deviations in the course of the torpedo is concerned, consists in so placing the rotation axis of the flywheel as to obtain a resultant axis of motion in the case of deviating forces acting on the torpedo, and in combining with the flywheel thus placed certain steering mechanism brought into action by the resultant motion, and arranged and automatically operating to set up opposite deviating forces which will counteract and neutralize the unusual extraneous deviating forces. The Whitehead torpedo, on the other hand, includes a gyroscope placed in the torpedo with the axis of the flywheel parallel with the longitudinal axis of the torpedo. The Court finds that the system of steering in the Whitehead torpedo is not only not dependent upon "resultant motion," but becomes ineffectual in proportion as such motion occurs. The Whitehead steering gear depends upon fixity of the axis and rings unaffected by an extrinsic force; the Howell steering mechanism depends upon the introduction of a higher force that destroys this fixity and produces an abnormal operation of the gyroscope, causing the ring to change that status which the revolution of the flywheel tends to produce. The possibility of resultant motion is indispensable; its occurrence in the torpedo is a detriment; in the Whitehead it tends to baffle the operation of the steering gear; in the Howell the evil is turned to its own correction. In the light of these differences the Court dismissed the complaint, holding that the steering mechanism used in the Whitehead torpedo shows a meritorious advance in the art and that it may not be considered as an infringement of Admiral Howell's invention.

Trade-Mark Infringement.—In an action brought to restrain William A. Fors and Harry D. Dye from using certain labels, upon the ground that they were infringements upon those adopted by the plaintiffs, William B. and Bernhard Volger, it appeared that the plaintiffs had for nine years manufactured inking pads and had adopted the word "Excelsior" and a descriptive label bearing the words "Excelsior Felt Pads," and that the product had become known to the trade as the "Excelsior Pad," that the defendants after purchasing the Excelsior pads for nine years "stopped doing so and placed upon the market felt pads under a label which was an excellent copy of that adopted by the plaintiffs except for the word 'Excelsior.'" By the trial court, a decision was given for plaintiffs. Judge Ingraham, in delivering the opinion of the Court when the case came up for review by the Appellate Division of the Supreme Court of New York, stated that there was not the slightest doubt but the defendants by merely changing the word "Excelsior" to "Excellent" and adopting the remaining portion of the label of the plaintiffs, were guilty of an infringement which was a fraud upon the public. The defendants laid great stress upon the fact that there was no name upon this label, implying that a person could not acquire a valid claim upon a trade-mark unless his name was a part of the trade-mark. This novel proposition, the Court held, was entirely opposed to the principle upon which a trade-mark when adopted becomes property which a court of equity will protect.

Invention—Evidence of Commercial Success.—Where, in the device of a patent, the departure from former means is small, yet the change is important, the doubt as to whether the inventive faculty has been exercised is to be weighed in view of the fact that the device in question has displaced others which had previously been employed for analogous uses, and this may decide the issue in favor of invention, especially where other inventors, of experience and skill in the art, had unsuccessfully attempted to solve the problem presented. Star Brass Works *vs.* General Electric Company, 111 Fed. Rep. (U. S.) 398.

Garbled Letter Used to Mislead.—Complainant published a letter announcing to the public that he was engaged in writing a life of President McKinley, and giving the name of the publisher. He further stated that there was being advertised another "Life of McKinley," purporting to have been written by him; that in 1896 he had prepared a campaign publication regarding the then Republican candidates for President and Vice-President, which he understood was being changed and sold as his "Life of McKinley," but that he had not had anything to do with such book since its first publication. Defendant, who was publishing and selling still another book on the same subject, issued a circular in which he copied that part of complainant's letter which denied his connection with the second work mentioned therein, but omitted the portion relating to complainant's new work, and added an endorsement, which, in connection with the extract printed, was calculated to mislead the public by inducing the belief that any book offered as complainant's was fraudulent and not authentic. The proofs showed that such circular in fact created the confusion in regard to complainant's book which it was the purpose of his letter to prevent. Held—that such circular was constructively fraudulent, even if not so intended, and its promulgation caused an injury to complainant, against which he was entitled to protection of injunction. Halstead et al. *vs.* Houston, 111 Fed. Rep. (U. S.) 376.

The "Argonaut" and Holland Submarine Boats in Court.—Suit has been brought by the Electric Boat Company, builders of Holland submarine boats, against the Lake Torpedo Boat Company, designers and builders of the "Argonaut," a vessel designed for submarine navigation and fitted with exterior driving wheels so that it may crawl along the bottom. Damages to the amount of $100,000 are claimed. The builders of the Holland boat allege that their patented arrangement of ballast tanks, storage batteries, and means for controlling the direction of the vessel's motion have been infringed. The outcome of this suit will be watched with interest.

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

MECHANICAL MOVEMENT.—EDWARD A. MAINGUET, Evangeline, La. The invention is an improvement in mechanism which is preferably adapted for operating the cutter-bar of a mower or reaper, but which is also capable of general application and use whenever it is desired to transmit motion to a reciprocating part by means of an endless belt. A rocking-lever is arranged to operate in a plane between the runs of the belt; and a bar is held to the belt and deflected thence inwardly and engaged with the lever. Thus the lever is operated by the movement of the belt.

Engineering Improvements.

GENERATING MOTIVE POWER.—RUDOLPH STENERSEN, Brooklyn, New York city. Mr. Stenersen has devised improvements in generating motive power whereby explosive charges are successively exploded in an explosion-chamber connected with a pressure storage-chamber, to store the force of the explosion in the storage-chamber, and to utilize the pressure obtained for driving machinery.

IGNITER FOR EXPLOSIVE-ENGINES.—JOHN T. METCALFE, Quincy, Pa. The igniter comprises an electrical circuit provided with separable contacts for producing sparks. A rocking-shaft actuates one of the contacts. Rigidly mounted on the rocking-shaft is a lug, provided with an anvil-face. A spring-driven hammer is loosely mounted upon the rocking-shaft, and is free to strike the anvil-face. A rocking-lever, loosely journaled on the rocking-shaft, has a catch for engaging the hammer, which catch is released by a movable arm. Since the adjusting-lever can be used so as to govern the period when the spark is made relatively to the position of the main shaft, the spark can be made at any desired point within reasonable limits relatively to the stroke of the engine.

Electrical Apparatus.

INSULATING-CONDUIT FOR CONDUCTORS OF ELECTRICAL TRAMWAYS.—PAUL C. SEGUY, Rue de la Héva, 9, Paris, France. The invention relates to a system of insulation for electrical-tramway conductors, whereby danger to the foot passenger is avoided, as well as to vehicles. The insulator comprises a block of insulating material having a channel formed therein for the conductor. The block is provided with means for the escape of water from the channel. A block arranged below the insulating-block forms a channel for the water.

Hydraulics.

TANK.—GEORGE BECKING, 12th Street and C. S. R.R., Chattanooga, Tenn. The invention is an improvement in water-closet tanks and other reservoirs and provides devices for securing operation of the flushing-valve after filling. Means are likewise provided for preventing the overflow of the tank in case the devices for automatically controlling the supply should become inoperative.

WATER-JOINT.—MATTHIAS GARVEY, Crown Point, N. Y. Heretofore great difficulty has been experienced in connecting the water-pipe with the drill-rod, since the drill-rod must turn continuously and the water-pipe remains stationary. Owing to the necessary movement of the parts, it has been found very difficult to pack the connection between these two elements. To overcome these objections Mr. Garvey has devised a water-joint comprising a thimble through which the pipe passes, the thimble having a counter-bar to form a cavity. Into the cavity a cap is screwed. A packing is carried fast on the water-pipe and is situated within the cavity. Ball-bearings are placed between the packing and the cap.

FAUCET AND VALVE.—EDWARD A. POHLMAN, Manhattan, New York City. In this construction, the valve-seat is conical and is removable from the barrel or casing of the valve. The valve itself is spring-controlled, and is fitted to the conical seat. The construction is such that concussion or hammering is prevented. A bonnet for the valve-casing serves as a fulcrum for the lever which operates the valve.

Mechanical Devices.

CINEMATOGRAPHIC APPARATUS.—AUGUSTUS ROSENBERG, 12 Southampton Row, London, England. The direction of motion of the film is automatically and instantaneously reversed (without reversing the direction of motion of the motor or handle) when the film has been traversed in the one direction and the position of the lens barrel is altered automatically and coincidentally with the change of direction of motion of the film. Hence the film is exposed to the extent of only one-half of its width when running in the one direction and to the extent of the other half when running in the other direction.

CLUTCH.—CHRISTIAN JOHNSTON, Elgin, Ill. This clutch, especially designed for use in winding up springs in motors and other instruments requiring winding up and braking, is arranged to turn the shaft on a forward motion and release or brake the shaft on a return-stroke. Two clutch members are employed, of which one is secured to the shaft and the other mounted to rotate loosely and concentrically on the shaft. The two members are locked together with a swiveling connection that precludes lateral separation. One of the members has flat faces on which are mounted loosely balls or rolls pressed on by springs, so as to insure the contact of the rolls or balls with the rims.

DRIVING-GEAR FOR BELTED MACHINES.—FRANK FRIGERIO, White Haven, Pa. The object of the invention is to provide an improved driving-gear for spinning-machines, arranged to permit proper adjusting and tightening of both runs of the driving-belt to insure a uniform rate of speed for the spindles to be driven. The invention is applicable not only to spinning-machines, but to any machine driven by belt, rope, or cable.

HORIZONTAL BORING-MACHINE.—DEFIANCE MACHINE WORKS, Defiance, Ohio. This machine is the latest design of Mr. George A. Ensign, one of the most fertile inventors of woodworking machinery. The horizontal boring-machine is an improved construction, and is arranged to insure a regular and uniform feed to produce smooth and true holes without the employment of skilled labor or without any effort on the part of the attendant of the machine.

Tools and Apparatus for Special Purposes.

PENCIL-SHARPENER.—AMOS T. FOX, Tacoma, Wash. The pencil-sharpener is operated like a pair of scissors. A long or a short point can be produced quickly and conveniently without breaking the lead or soiling the hands. The device comprises pivotally-connected body members, a pivoted pencil receptacle, and an adjustable knife adapted to enter and to have movement in the pencil receptacle.

SLIDE LOOP-CLIP. ISAAC GOURES, Manhattan, New York city. The clip is intended to hold a strap or loop as adjusted on a belt of elastic webbing. The device is simple in construction and serves to prevent the loop or strap from sliding along the web. The clip is furthermore so designed that it will not cut into the web or soil it.

CASING HEAD FOR OIL WELLS.—JOHN W. FRYE, Station So. Side, Oil City, Pa. Sometimes a derrick is blown down, with the result that the tubing is broken and the lower section drops down into the wells. To recover such a section involves much time and trouble. Mr. Frye makes the tubing which extends down into the well separate from the stand-pipe rising into the derrick and provides a special construction of casing head, which holds the tubing in a suspended position and at the same time connects the tubing and stand-pipe with a closed joint, thereby permitting a continuous flow of oil upwardly without waste.

Vehicles and Their Accessories.

DRAG.—MARTIN LEATHERMAN, Garden City, Minn. The invention is especially adapted to wagons and sleighs to prevent them from running down inclines covered with ice or snow. The drag is adapted to be applied to the vehicle under the wheel or runner, and to support it on the ground, the engagement of the drag with the ground holding the vehicle back sufficiently to prevent its crowding the team.

Miscellaneous Inventions.

NON-REMOVABLE BUNG.—CONRAD ZWICKEL and LEO P. GRUNBAUM, Boise, Idaho. This bung for wooden receptacles for malt or other liquors is non-removable without its destruction after it has been driven into the bung-hole. Hence the adulteration of a choice brand of liquor is prevented or exposed by the necessary substitution of a differently constructed bung.

NECKWEAR.—JENNEY A. TURNER, Norfolk, Va. The inventor has devised a stock-tie which has a body to be wrapped around the neck, an extension at one end of the body, and two tie ribbons at the other end of the body, these tie ribbons being each capable of half-encircling the neck and of being tied together. The tie sets well and attractively on the neck.

FOLDING TABLE.—SIMON M. SNOOK, Scranton, Pa. The present invention is a new and improved folding table arranged to be very firm when set up, and adapted to permit the user conveniently to fold and store it in a small space. The table is intended primarily for ironing, although it may be used for other purposes.

MATCH-BOX.—CAESAR SCHAER, Superior, Neb. The box is useful for carrying matches or snuff. The manner of opening the box is kept a secret by the user. A device is included in the construction which has every appearance of being the real means of opening the box, but which carries a pin to pierce the finger of the person who presses it.

PEN-HOLDER.—CHARLES W. BARKLEY, Seward, Neb. This invention relates to a penholder of such construction that the pen can be held conveniently; and yet, when it is desired to do so, the pen can be ejected without the necessity of applying one's fingers to it.

NON-REFILLABLE BOTTLE.—JOHN S. BROMHEAD, Brooklyn, New York city. This non-refillable bottle is designed to contain Worcestershire sauce, catsup, or any semi-liquid. The peculiar means for preventing the refilling are as simple as they are ingenious.

HOOF-PAD.—JOHN CAMPBELL, Manhattan, New York city. The hoof-pad is to be used conjointly with a horseshoe and serves to furnish a cushion which bears the force of the blow of the hoof on the ground. The pad is provided with an air-chamber running continuously around the length of the pad and having an opening into the atmosphere.

NON-REFILLABLE BOTTLE.—WILLIAM C. LEAK, San Antonio, Tex. The non-refillable bottle is of such construction that the liquid is prevented from being poured back into the bottle by a check, seated on the lower part of the neck and controlled by a plunger, which when the bottle is turned into upright position enables the check to move from its seat, thus permitting the liquid to run out of the bottle.

POST-SECURING DEVICE.—WILLIAM NEWMAN, Alexandria, So. Dak. This device is intended for use on posts, stakes, and piles to prevent them from splitting while they are being driven in the earth. The simple construction provided can be readily applied to the post and will adapt itself to the cross sectional shape, and can be tightened to bind the post so that it will not split.

COCK FOR GAS-FIXTURES.—JAMES D. STURGIS, Chicago, Ill. The cock completely cuts off the flow of gas to the burner when the cock-plug is turned in one direction until its rotation is arrested by a stop. A graduated but diminished flow to the burner is permitted when the plug is turned oppositely until arrested by another stop. The full flow of the gas is obtained when the plug is adjusted so as to locate projections between the stops on the body of the burner.

HORIZONTAL SWING.—CHARLES A. SCHINDLER, Jr., West Hoboken, N. J. Mr. Schindler has provided a new and improved horizontal swing, which in construction is simple and durable, and which is arranged to insure an easy turning of the rope-supporting frame, by reason of an ingenious ball-bearing arrangement at the pivot portion of the swing.

WHEEL ATTACHMENT FOR CHILDREN'S HIGH CHAIRS.—ISAAC M. CLARK, Lompoc, Cal. Mr. Clark has provided the rear legs of a child's high-chair with wheels supported upon novel clamps. The clamps are readily attachable. When in place the clamps serve to prevent the restless movement of the child from tipping over the chair. The attachment, however, serves not only to prevent rearward tipping, but also for moving the chair in any direction.

NECKTIE HOLDER.—ZALAL GUZIK, Manhattan, New York City. The inventor has devised an improvement in means for holding four-in-hand neckties in connection with a button and turn-down collar. The tie is suitably held without passing it around the collar. A clip of novel construction is provided which serves not only as a convenient attachment between the tie-shield and the collar-button, but also to strengthen the central portion of the shield, where it is most likely to break.

Designs.

SHINGLE.—GEORGE F. MURDOCK, Wellsville, Ohio. The leading feature of this design is to be found in the shield-like formation of one end portion.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

PRACTICAL DIETETICS. Food Value of Meat. By W. R. C. Latson, M.D. 16mo. Pp. 72. Price 50 cents.

The matter of meat eating is becoming an important subject of consideration, and in this manual Dr. Latson shows quite clearly that all the fatty elements found in meat can be obtained by the use of other products, as cereals, nuts, vegetables, fruits, etc., avoiding the use of foods that are likely to be unhealthful.

OUR FERNS IN THEIR HAUNTS. A Guide to All the Native Species. By Willard Nelson Clute. Illustrated by William Walworth Stilson. New York: F. A. Stokes Company. 1901. 12mo. Pp. 332. Price $2.15.

The author has paid special attention to the haunts, habits, uses, folk-lore, structure, growth, abundant distribution and varieties of ferns, covering a greater range and covering more species than are mentioned in any other similar work. Every common or English name is given, together with the scientific names of both the old and the new nomenclatures, with a discussion of the origin and application of these names. It contains a most valuable illustrated key to the families. The illustrator has supplied more than 200 beautiful illustrations, in color, in wash and in pen-and-ink. It is a delightful book.

ELECTRICAL CATECHISM. An Introductory Treatise on Electricity and Its Uses. By George T. Shepardson, M.E., New York: American Electrician Company. 1901. 8vo. Pp. 403. Price $2.

The work here presented is a revision and enlargement of the Electrical Catechism which was first published in Electrical Industries and continued in the American Electrician. It is designed to answer the numerous questions that continually come up in the houses of those who come in contact with any application of electricity. The topics are selected from personal questions and letters, and from the queries noted in electrical papers, these being supplemented by others intended to prepare the way and to make the treatment more consecutive and comprehensive. The result is a book of great value for all students of electrical engineering. It is a mine of valuable material.

PRIMITIVE MAN. By D. N. Hoernes. London: J. M. Dent & Co. New York: Macmillan Co. 1901. 16mo. Pp. 135. Price 40 cents.

One of the admirable little Temple series, which is well adapted to give the reader an idea of the principles of anthropology.

A HISTORY OF THE PRECIOUS METALS FROM THE EARLIEST TIMES TO THE PRESENT. By Alexander Del Mar, M.E. New York: Cambridge Encylcopedia. 1902. 8vo. Pp. 480. Price $3.

The present work is based on a previous edition published in 1879. The arrangement of the first work was by epochs. The present arrangement is by countries, involving an entire rewriting and revision of the work by the author. Its scope is very broad, and the bibliography which the author cites is most imposing. The amount of valuable information relative to the precious metals of all countries is really remarkable. It is a most beautiful book.

CONTRIBUTIONS TO MINERALOGY AND PETROGRAPHY. From the Laboratories of the Sheffield Scientific School of Yale University. Edited by S. L. Penfield and L. V. Pirsson. New York: Charles Scribner's Sons. 1901. 8vo. Pp. 842. Price $4.

This volume comprises a series of reprints of some of the most important of the papers containing the researches made in the chemical, mineralogical and petrographical laboratories at Yale. In the lines of mineralogy and petrography, it is believed that gathered from foreign scattered sources and put into this compact form they will prove a useful addition to the literature of these closely allied sciences. The first editor is responsible for the mineralogical portion, and the second for the petrographical part. The work is of great value and a monument of patient and careful research.

3,500 QUESTIONS ON MEDICAL SUBJECTS ARRANGED FOR SELF-EXAMINATION. Philadelphia: P. Blakiston's Son & Co. 1901. 32mo. Pp. 217. Price 10 cents.

It would appear that any one who could answer the 3,500 questions proposed in this quizbook ought to be given a degree of M.D. on the spot. It is an excellent little work which can be commended to every medical student, and it will also assist the practitioner in brushing up his rusty points. The right-hand page is left blank for memoranda.

A HANDBOOK FOR APPRENTICE MACHINISTS. By Oscar J. Beale. Providence, R. I.: Brown & Sharp Manufacturing Company. 1901. 16mo. Pp. 141. Price 50 cents.

This book is for learners in the use of machine tools, and is the outgrowth of the needs of the company referred to above in the instructing of apprentices. It was felt there was too much uncertainty in depending upon oral instruction to impart the information in some details, which every apprentice is entitled to receive. An experimental edition of this book has been printed and has proved useful. The present edition is carefully revised and enlarged with the hope that it will be still more useful. Various subjects, such as centering, turning, drilling, tapping, etc., are treated, as well as pulley speeds, gear speeds, chain gears for screw-cutting, the reading of drawings and kindred subjects.

GEOMETRIC EXERCISES IN PAPER FOLDING. By T. Sandara Row. Edited and revised by Profs. Beman and Smith. Chicago: The Open Court Publishing Company. 1901. 12mo. Pp. 148. Price $1.

An examination of Sandara Row's geometrical exercises in paper folding convinces the editors of its undoubted merits and of its value to American teachers and students of geometry. The exercises do not require mathematical instruments, and an envelope of selected papers accompanies each volume.

GESCHICHTEN VON DEUTSCHEN STAEDTEN. By Prof. Menco Stern. New York: American Book Company. 1902. 12mo. Pp 420. Illustrated with Map of Germany and 14 engravings.

Encouraged by the success of his earlier book, "Geschichten vom Rhein," Prof. Stern has written another volume of short stories of interesting German cities and towns. These legends and tales of the founding and history of well-known places serve to fix them in one's memory, and to give each a distinct individuality. The stories are told in a simple, terse style, showing considerable literary merit, and will be found most interesting reading, not only by the student with a slight knowledge of German, but also by anyone thoroughly conversant with it. To a person about to take a trip through Germany these legends will furnish a pleasant introduction to its many fine cities and often suggest places of interest to be seen when visiting them. The book is excellently printed in clear German type and is furnished with a complete vocabulary.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 1994.—For manufacturers of paste-mixing machinery.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 1995.—For dealers in titanium steel points.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 1996.—For manufacturers of brass ornaments for cabinet workers.

Stencil Machines.—A. J. Bradley, 101 Beekman St. N.Y.

Inquiry No. 1997.—For magnifying lenses 2½ x 1½, focus 3½ inches.

For bridge erecting engines. J. S. Mundy, Newark, N. J.

Inquiry No. 1998.—For a machine for weaving wire fabrics for the tops of spring mattresses.

Sheet metal stamping and light manufacturing. Forske Motor Co., Anderson, Ind.

Inquiry No. 1999.—For a second-hand 30 or 36-inch lathe.

Glass paper-weights for advertising. Write for prices. Lobmiller Co., Wellsburg, W. Va.

Inquiry No. 2000.—For manufacturers of pulverizers or disintegrators.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 2001.—For manufacturers of engine castings.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 2002.—For makers of air compressors.

FOR SALE.—A perfect sad iron, just patented. Michael Joyce, Box 174, Salt Lake City, Utah.

Inquiry No. 2003.—For makers of small magnetic clutches.

For sheet metal stampings and novelties try Standard Stamping Co., Seventh and Hudson, Buffalo, N. Y.

Inquiry No. 2004.—For manufacturers of small stamping outfits.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 2005.—For makers of gasoline engine castings for marine use.

Are you looking for anything in bent woodwork? Write Tucker Bicycle Woodwork Co., Urbana, Ohio.

Inquiry No. 2006.—For manufacturers of nickel-plated or German silver wire.

Manufacturers of the handsomest postal scale in the world, cheap. C. W. Novelty Co., Wallingford, Conn.

Inquiry No. 2007.—For gong-shaped metal bells for musical work.

Machine Work of every description. Jobbing and repairing. The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 2008.—For manufacturers of hydraulic dredges and dredging machinery.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 2009.—For the address of the manufacturers of the "O. K." batteries.

Designers and builders of automatic and special machines of all kinds. Inventions perfected. The W. A. Wilson Machine Company, Rochester, N. Y.

Inquiry No. 2010.—For parties making artificial teeth for papier maché animals' heads.

FOR SALE.—Patent potato gatherer, 683,737. August H. W. Eikmeier, Manning, Carroll County, Iowa.

Inquiry No. 2011.—For manufacturers of automobiles of 6, 8 or 10 seating capacity.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 2012.—For makers of 1-inch pipe dies, with 14 threads to the inch.

WANTED.—Makers of bicycle road propeller, rowing motion. Louis C. Lindeman, 18 Broadway, New York.

Inquiry No. 2013.—For a telescope of about 3 inches.

EXPERIMENTAL MACHINE SHOP.—We are not using our shops at present. Well equipped with lathes shaper, woodworking machinery, etc. Will rent use and power very low. Fine place for automobile work. Billings Clapp Co., Boston, Mass.

Inquiry No. 2014.—For manufacturers of knock-down barrels.

Someone in need of ad. manager, can secure services of man who will demonstrate his ability to advertise your business in a striking way. Originality of ideas, success of methods, knowledge of periodicals are his recommendations. J. H. B., Box 773, N. Y.

Inquiry No. 2015.—For machines for making paper bags.

FOR SALE.—The patent of a new machinists' tool, either outright or on royalty. L. Williams, Johnstown, Pa.

Inquiry No. 2016.—For new or second-hand animals for a merry-go-round.

Inquiry No. 2017.—For parties to weave belts of cotton cloth 12 inches wide.

Inquiry No. 2018.—For colored glass and lead used in making fancy glass windows.

Inquiry No. 2019.—For tools and material for making canvas gloves and mittens.

Inquiry No. 2020.—For plans, etc., of amusement schemes, such as roller casters, shoot the chutes, etc.

Inquiry No. 2021.—For dealers in Mannesmann tubing and bottles.

Inquiry No. 2022.—For the manufacturers of centrifugal machines for the clarifying of beer and wine.

Inquiry No. 2023.—For drills for boring rocky soil, to bring up the soil for examination.

Inquiry No. 2024.—For nickel steel used in sparking points for gasoline engines.

Inquiry No. 2025.—For machinery for grinding, separating and refining graphite.

Inquiry No. 2026.—For attachments for bicycles to be run on a railroad.

Inquiry No. 2027.—For manufacturers of vacuum pans and pumps,

Inquiry No. 2028.—For a machine which can bend or form angle or tee iron used for scrolls or various sheet iron work.

Inquiry No. 2029.—For a plant for burning garbage.

Inquiry No. 2030.—For machinery for making macaroni.

Inquiry No. 2031.—For makers of turbine water wheels.

Inquiry No. 2032.—For air receivers 15 inches diameter by 15 feet long, to stand 500 pounds pressure to the square inch.

Inquiry No. 2033.—For makers of German enamel heating stoves in which the fire is made at the top.

Inquiry No. 2034.—For manufacturers of gages calipers, dividers, etc., for machinists' use.

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Gas generator, acetylene, A. Myers 691,959
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Gas or vapor burner and stove, hydrocarbon, Bowman & Clouse 692,110
Gas retort stopper, inclined, A. F. P. Hayman 691,940
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Gun mount, S. N. McClean 691,912
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Harvester, corn, C. Colahan 691,748
Harvester, corn, A. V. Kiser 691,782
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Head rest, Greer & Harris 691,854
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"Solid Steel," for steel soda-water tanks, R. M. Green & Sons..... 458

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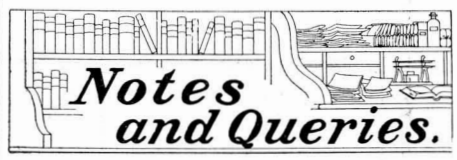

HINTS TO CORRESPONDENTS.

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References to former articles or answers should give date of paper and page or number of question.

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(8509) G. F. writes: In letting the air out of my hot-water heating radiators to-day, I found on applying a match to the air that it burned readily and strongly, giving a blue and partly white flame. The radiators are filled with city water, which is taken from a well about 400 feet deep, the last 35 feet being in sand rock. Why does this air burn? Is there any danger in using this water in the radiators? A. A small quantity of inflammable gas is often found to issue from the air vents of radiators. It is principally hydrogen, supposed to be liberated by the oxidation of the iron in the heating apparatus. It is harmless.

(8510) W. C. T. asks: 1. In issue of October 26 was an account of lifting magnets lately brought into use for moving heavy pieces of metal. What expenditure of magnetic or electric force occurs in lifting 100 pounds ten feet high? A. There is the same expenditure of magnetic force in lifting 100 pounds of iron by a magnet as by any other method. 1,000 foot-pounds are required to lift the weight. 2. What I wish to know is whether a working magnet loses force or not by reason of work. A. The magnet loses no force by lifting. 3. Is the nature of magnetism understood? Also if a magnet and an electro-magnet are alike in conservation of force? A. The nature of magnetism is not known. All the forces of nature are mysteries. We believe the conservation of energy is applicable to all forces. 4. About a year since there was considerable discussion about wind pressure, and it seemed to me that the subject was not thoroughly understood. My theory is that in case of a heavy wind against any object the pressure is not proportioned to the size of the object, for this reason: Let the object be the side of a house standing square to the wind. The air close to the house has no motion, and there is a wedge-shaped body of slightly compressed air which splits the wind and diverts part of its force, as anyone may discover by standing on a street corner on a windy day. A. Experiments have proved that wind pressure is in proportion to the area on both small and large bodies. The pressure is transferred to a plane surface through the banked cone against it, and the pressure at a central point on the surface corresponds with the pressure due to the velocity of the wind, which increases the density of the air in the central portions of large surfaces.

(8511) E. J. H. asks: Is there any substance through which magnetic lines of force cannot pass, or is there any way to produce a beam of magnetic force, as light is reduced to a beam on passing through a crevice? A. Iron constitutes the only screen for magnetism. The lines of magnetic force always proceed from a magnet pole and curve around to an opposite pole. The only way in which they can be made to go in straight lines is to place a second and opposite pole over against the pole from which the lines originate.

(8512) F. R. M. asks: 1. Ganot gives the velocity of sound in rubber as 100 feet per second, and in steel 16,000 feet per second. I cannot reconcile this with the formula $v = \sqrt{\frac{e}{d}}$ for as the terms are usually understood elasticity is greater and density less in rubber than in steel. Just what does elasticity mean in this sense? A. The "elasticity" employed in calculating the velocity of sound in a solid is Young's modulus of elasticity. This is the number of pounds used to stretch a bar of a square inch cross section, divided by the elongation produced in one inch of the length of the bar. Now, it requires an enormous number of pounds to produce a small elongation in a bar of steel of one inch section and one inch long. The quotient of the number of pounds divided by the elongation is a large one. It requires a small number of pounds to stretch a bar of india rubber quite a distance. The quotient found as before is small. In other words, rubber is not very elastic as compared with steel. Nor do we use rubber as we use steel for its elasticity. You will find this in Ganot; the reference is on the same page as the figure you quote for rubber. 2. In Fizeau's experiment on the velocity of light, why does not the returning beam destroy the one that is going to the mirror, and so produce darkness? Would this be the case if the beam were a single ray? A. Waves must cross each other in opposite phases to produce extinction. In the case of light the effect of interference is to produce bands of light and darkness, very difficult to see except with special apparatus, and in a dark room. When the waves have crossed they move on as before. Interference of waves does not stop the waves. Water waves cross each other, interfering as they do so, and then flow forward as before. So also do light waves. 3. In an organ pipe how can waves pass in opposite phases without destroying each other? In other words, why does not the formation of a node destroy completely the wave from each direction? A. The above answer applies to this question also. A node is a point in a stationary set of waves. The waves are passing and repassing through the node. 4. Ganot says violet rays are 76×10^{13} per second. Lodge, quoted in Fahie's "Wireless Telegraphy," says 76×10^{14}; and in Kerr's "Wireless Telegraphy" it is given as 76×10^{10}. Which is right? A. We do not know. They only differ slightly. We should have more confidence in Ganot. The wave length is the important factor. This divided into the velocity of light gives the number you quote. 5. How is it proved that light waves are transverse vibrations? A. The phenomena of light better accord with the theory of transverse than of longitudinal vibrations.

(8513) A. F. O. asks: In installing an electric stereopticon requiring from 7 to 18 amperes obtained from a commercial 220-volt wire, I am told that I must reduce the current by means of an adjustable rheostat. Could it not be done as well and more cheaply by means of a shunt? A. A rheostat is generally employed in controlling an arc lamp for the stereopticon. The drop of voltage in the arc is about 50. The rest of the drop is in the rheostat. If 15 amperes are to be provided for, a rheostat of at least 12 ohms will be required. These are to be had from all dealers in lanterns, etc. See our advertising columns.

(8514) G. W. H. asks: 1. In regard to a fluorescent fluid, you very kindly informed me in your issue of July 24, to use a solution of quinine, with a little acid, hydrochloric or citric, with a violet-colored glass. As I have not been successful, will you kindly tell me the proportions to use? A. No particular proportions are required. Dissolve as much as the water will take. Of course you understand that the effect must be seen in a dark room, with the light from the lantern falling upon the paper wet with the solution, or the bottle containing the solution. 2. Also can you inform me what fluids I can use, and the color of glass for each, to produce red, blue or black color on white paper? A. The color of the paper has no effect upon fluorescence. 3.

(Continued on page 98)

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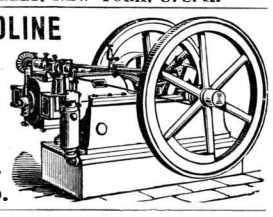

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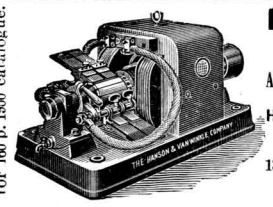

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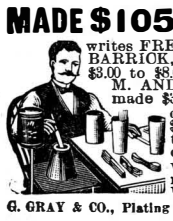

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(8515) G. C. writes: In Notes and Queries of December 7 (8470) J. O. J. asks what is the true theory of the inflow and outflow of wind that obtains in the caves of South Dakota. Permit me to say that the true solution is to be found in the operation of the laws of gravitation, or in other words in barometric conditions rather than thermal. To illustrate: Let us assume that there is an equilibrium in the specific gravity of the air within and without the cave. A sudden change takes place in the outer air, its specific gravity being increased; the more weighty air from without will rush through the narrow entrance to the cave to maintain the barometric conditions within and without; and *vice versa*, when the air within the cave is heavier than it is outside, there will be a corresponding outflow. The velocity of the in and outflow will be in the ratio of the atmospheric changes taking place, and the existence of space within determining the volume of air to be forced in and out. The foregoing theory is, I think, fully demonstrated by the flowing and ebbing of the tide. Here is a narrow entrance to a wide and extended inlet: on the rising of the tide without, the water is forced with great force through the entrance until the surface of the water within is on a level with that without. There will be a corresponding outflow with the receding of the tide. Gravitation in both cases is the motive force. A. We presume our esteemed correspondent is aware that a change of temperature changes the density or specific gravity of the air, as he terms it, just as a change of barometric pressure does; and that the change due to heat is much more rapid and effective than the change in density due to a change of barometric pressure. A change of 15 deg. of the thermometer produces almost exactly the same change of density in the air as a change of an inch in the barometer. We have a change of 15 degs. in the thermometer almost every day between night and day. A change of an inch in the barometer is usually much more than a day in taking place. The change of pressure between the interior of a cave and the external air would appear to be dependent upon the change of temperature to a higher degree than upon the change of the pressure of the air as shown by a barometer.

(8516) A. writes: 1. Can I trouble you for an explanation of the cold produced by a body moving through the air, e. g., railway train, bicycle, fan? A. The sensation of coolness produced by rapid motion through the air is the same as that produced by a rapid motion of the air past one, as in fanning, sitting in the breeze, or in a draft of air. It is caused by the evaporation of perspiration. sensible or insensible, from the surface of the body. The moving air carries off the perspiration and brings a new supply of drier air into contact with the skin. This takes up its quota of moisture and moves on. The evaporation of the moisture from the skin is carried on by the heat of the body. When the action is rapid, the body is cooled more than when it is slow: hence in a breeze we feel cooler because the heat is taken more rapidly from the body to evaporate the moisture upon the surface of the body. It must be borne in mind that no water is evaporated except by heat. 2. Also, cold of combination of salt and snow? A. Salt by a chemical property has a strong affinity for water, and is able to melt ice, even at a temperature below the freezing point of water. The ice, however, cannot melt except it takes heat from some other body to melt it. This abstraction of heat cools the surrounding space. Thus ice cream is frozen by salt and ice.

(8517) M. M. asks: Will you please advise me as to the weight per horse power of a modern storage battery? And also, the weight per horse power of Mr. Edison's new battery? A. The number of pounds per horse power of a storage battery varies with the rate of discharge. With a slow discharge it is less for the same cells than for a rapid discharge. A rule has been given as follows: 0.53 ounce lead peroxide, and the same weight of spongy lead per ampere hour for a 10-hour rate of discharge; 0.62 ounce for a 5-hour rate; 0.70 ounce for a 3-hour rate; and 1 ounce for a 1-hour rate of discharge. This would give about 50 pounds per horse power at 10 hours discharge, and nearly 100 pounds for a 1-hour discharge. Manufacturers give various other figures for their cells. These are given in Foster's "Electrical Engineers' Pocket Book," just issued, price $5 by mail. The Edison storage cell is not yet before the public, and we presume no one knows what the number of pounds per horse power is for it.

(8518) R. H. M. writes: Replying to J. T. R. in Query 8461 you say that the same quantity of rain goes into the rain gage

(*Continued on page 99*)

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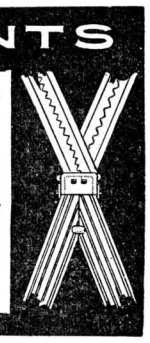

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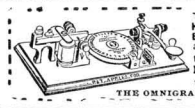

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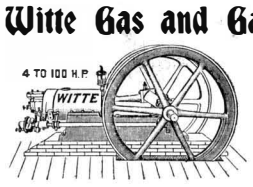

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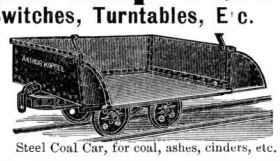

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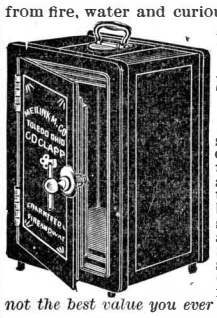

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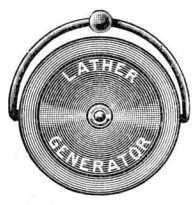

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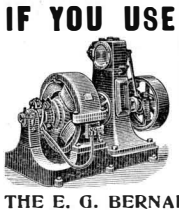

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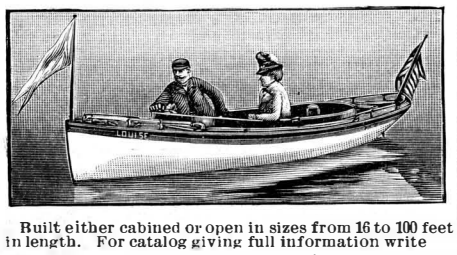
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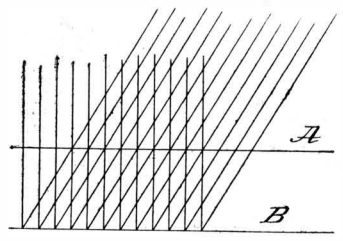
whether the drops fall obliquely or vertically, because in the former case the drops are nearer together. I do not seem to see it that way. I submit a diagram showing how it looks to me.



The drops of water in the same horizontal plane will be the same distance apart, whether they fall in slanting or perpendicular direction. The drops also pass between the two planes, A and B, in the same time, whether they pass in a slanting or straight direction. Manifestly, tilting the gage would make a difference because in so doing you would change or shorten the plane of the opening; changing the direction of the rain drops in the manner specified, however, does not change the number passing through a given opening in the same plane. A. The rain gage seems to have excited more interest than any other problem which has arisen in a long time. We will give a final word upon the subject. If rain falls vertically, and one inch of rain falls to the ground, the rain gage will show one inch of rain. That all are agreed upon. Now our additional statement is *if one inch of rain falls to the ground, at any angle of slope, a rain gage placed on the ground at that place will catch one inch of rain.* We do not see any escape from this conclusion. The cut in answer 8461 shows that fact. In order that an inch of rain should fall at a slant, the lines of the drops must be nearer together than if the rain fell vertically. There is no escape from that conclusion. If one inch of water falls upon a square foot from a storm and falls at a slant, the lines of rainfall will be nearer together than if it fell vertically from the cloud. Do not confuse the question. It is: With a given rainfall, will the drops be nearer together when the rain falls at a slant? It will be admitted by all that a rain gage set at the surface of the ground catches all the rain that the ground would receive if the gage were not there. Any other conclusion than this would be indefensible and inconceivable. The presence of the gage makes no difference (as has been before pointed out in the discussion) except for the eddies of the wind produced by the recess of the mouth of the gage. If one inch of rain falls upon a square foot, a rain gage set at that place will catch it; and if the rain falls at a slant, the lines of the drops will be nearer together than if it fell vertically.

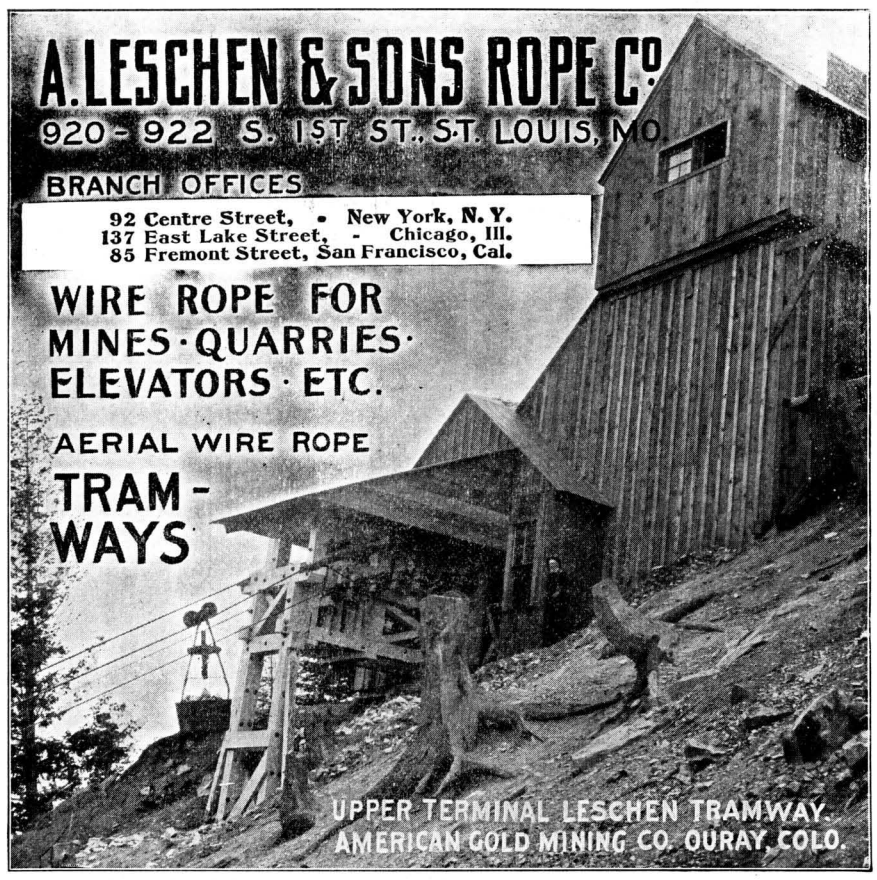
(8519) L. A. H. says: Please inform me as to whether there is a way by which the fly specks can be removed from chandeliers without taking them down. A. Have the water clean and boiling in two vessels. Dip in one water and then in the next as soon as taken from the nitric acid bath, so that there shall be no traces of acid on the fittings. Dry in box-wood sawdust while hot, and place upon a piece of hot sheet iron over a stove. As soon as all traces of water have left, quickly lacquer with very thin shellac varnish, using a camel's hair brush. You can make the lacquer by dissolving shellac in best alcohol. Do not touch the metal with the fingers before lacquering.

(8520) R. T. P. asks: Do you know of a material which is a non-conductor of electricity, which is as strong as steel, or do you know of a material which is nearly as strong? A. There is no other metal which is as strong as steel. If there were, it would not answer your purpose, since all metals are conductors of electricity. You seem to be seeking for a substance which does not exist.

(8521) H. A. H. asks: Can you inform me whether or not electricity is used on a phonograph while recording? If so, how? A. The phonograph is not an electrical apparatus, except that an electric motor is often employed to turn the cylinder. It can be turned by hand if any one prefers to do so. The phonograph is entirely an acoustic apparatns.

(8522) C. W. asks: If a rain gage was suspended on pivots like a ship's compass and having wing-like blades attached to the lower end of the gage, would it not in a high wind incline in the direction of the wind and give a more accurate record of rain fall? A. A rain gage fitted with wings to turn toward the wind would give too large a rain-fall. It would catch too much water, more than the same surface of the ground would catch. The rain gage should catch the rain which would fall upon an area of the same size as the mouth of the gage in the same circumstances.

(8523) W. A. M. asks: Will you answer through Notes and Queries whether or not the wind has any effect on a thermometer? That is if one thermometer is placed where the wind strikes the bulb, and another is placed so the wind cannot strike it, will they register the same? A. A thermometer in the wind should read lower than one in still air, unless the air is equally dry in both places. The reason is the same as for a person. A person feels cooler in a breeze than in still air because of the evaporation caused by the wind.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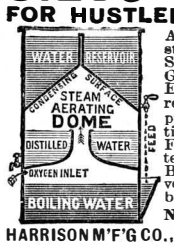

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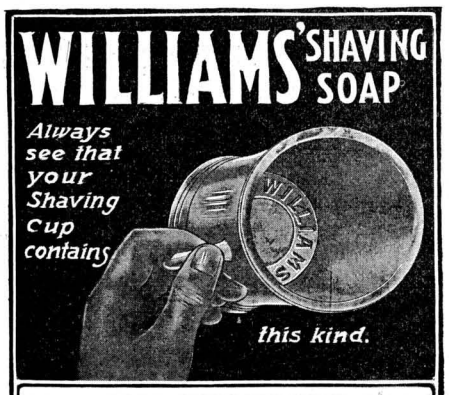

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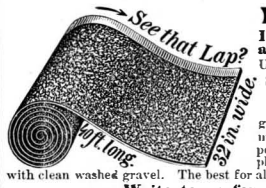

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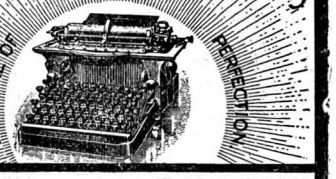

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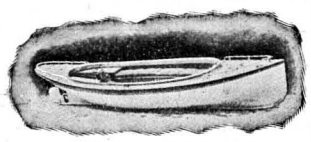

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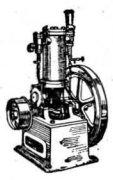

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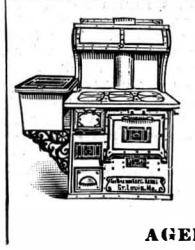

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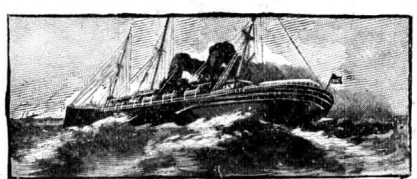

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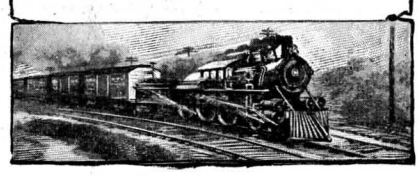

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